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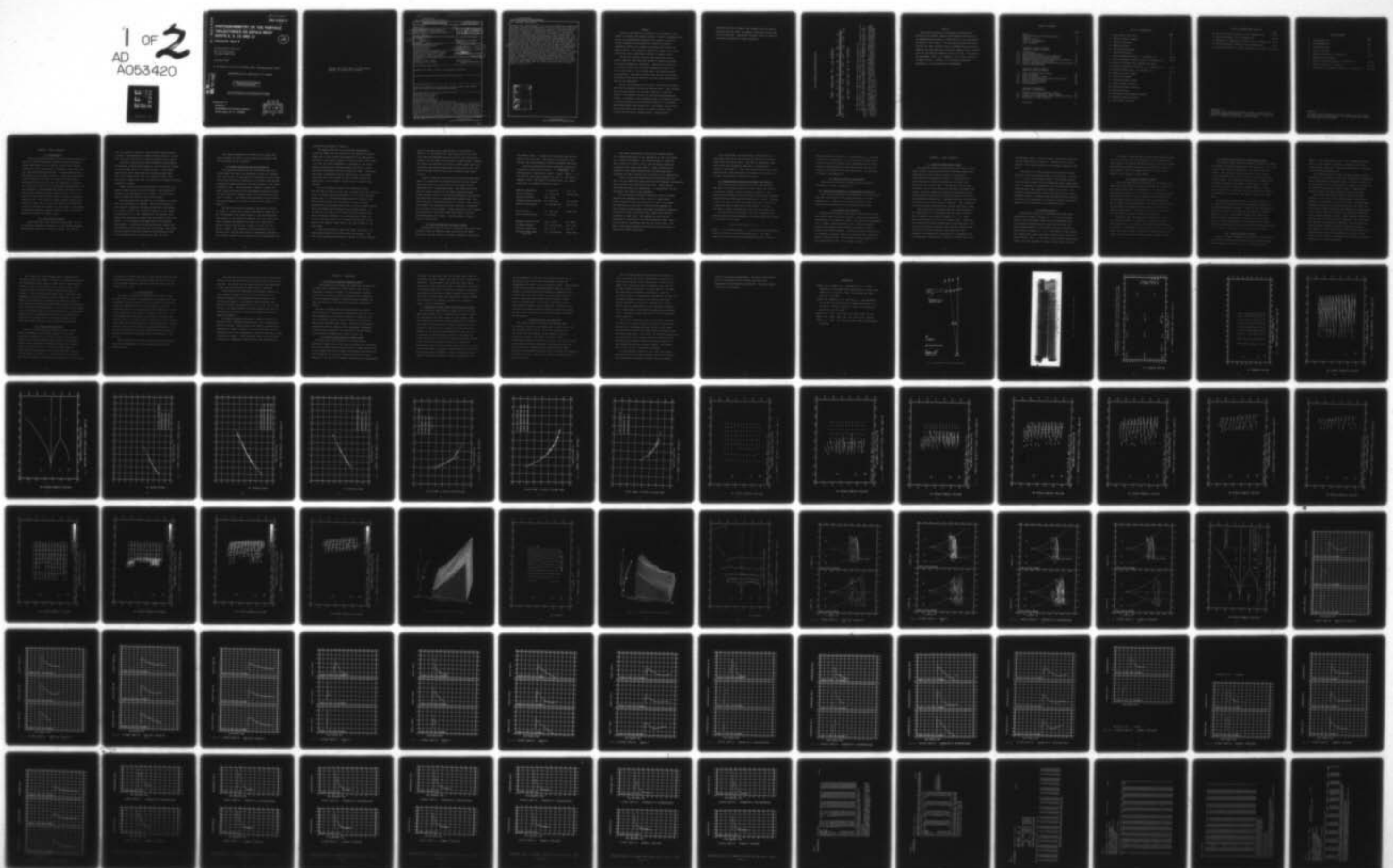

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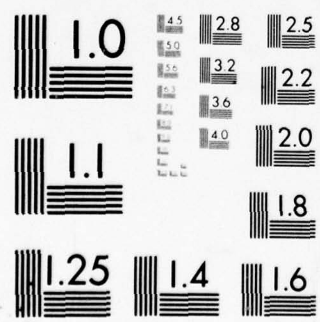

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PHOTOGRAMMETRY OF THE PARTICLE TRAJECTORIES ON DIPOLE WEST SHOTS 8, 9, 10 AND 11

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Volume II – Shot 9

University of Victoria
British Columbia
Canada V8W 2Y2

October 1977

Final Report for Period 15 May 1977—30 September 1977

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Volume 2 of this report describes the photogrammetry and analysis of the particle trajectories in blast waves produced by the simultaneous detonation of two spherical 1080-lb (491-kg) Pentolite charges, (Dipole West Shot 9). One of the charges was positioned at a height of 15 ft (4.6 m) above smooth ground and the second charge 30 ft (9.2 m) above the first. Photogrammetrical measurements were made of the trajectories of air particle flow tracers (smoke puffs), which had been placed in a vertical grid at heights (over)

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20. ABSTRACT (Continued)

ranging from 3 ~~ft (0.92 m)~~ to 58 ft ~~(17.7 m)~~ above the ground and at radial distances ranging from 25 ~~ft (7.6 m)~~ to 85 ft ~~(25.9 m)~~ from the vertical axis through the charges. From the measured particle trajectories, calculations were made of the particle velocities, densities, hydrostatic overpressures, and dynamic pressures throughout the blast wave, at times ranging from 3 ms to 60 ms after detonation ~~of the charges.~~ The shock front times-of-arrival were also determined from the photogrammetrical measurements for the primary shock from each ~~of the two~~ charges; for the Mach stems produced above and below the interaction plane midway between the two charges; and for the Mach stem produced at ~~the~~ ground surface. ~~From the shock front times-of-arrival, cal-~~
Cal culations were made of ~~the~~ shock velocities and, ~~in turn, the~~ peak particle velocities, air densities and hydrostatic overpressures immediately behind each shock. Calculations were also made of the variation with time of the particle velocity, density, hydrostatic overpressure and dynamic pressure at several fixed points. Results are presented both graphically and in tables, ~~and~~ are compared to results ~~previously calculated~~ for the same experiment using shock front photogrammetry and refractive image analysis. The analytical procedures used were similar to those used for Dipole West Shot 10, which were described in Volume I (Dewey, et al, 1977).

SUMMARY

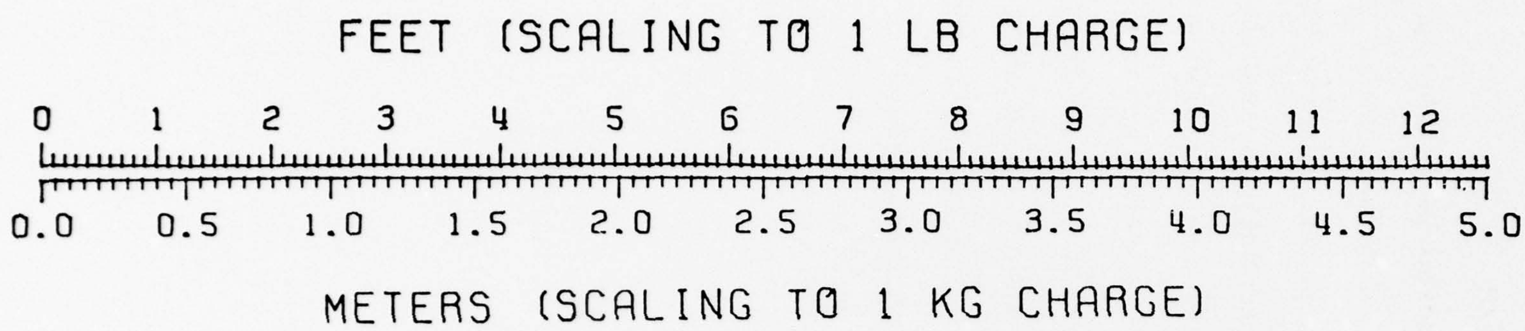
Owing to the quantity of material to be presented, this report is divided into several volumes. Volume 1 introduced the series and presented and discussed the results for Shot 10. Volume 2 presents and discusses the results for Shot 9. Subsequent volumes will present and discuss the results for Shots 8 and 11. The method of analysis is common to all four experiments and is described in detail in Volume 1 only.

So that the results from the four experiments may be easily compared, they have been scaled to remove the effects of varying atmospheric conditions. (Results are scaled to a 1 kg charge weight and a standard atmosphere of dry air at 15°C at sea level.) For the most part, only scaled results are presented. Exceptions include some derived pressure-time histories, which may be compared to actual gauge measurements made in the experiment.

Results are presented in SI units, even though the experiments were originally laid out in British units. Only distance and time measurements are affected, however, as velocity density, and pressure results are presented as dimensionless ratios. A distance units conversion scale is included on page 3 to convert between SI units (meters scaled to a 1 kg charge) and British units (feet scaled to a 1 lb charge), plus a time scale factor and scale factors to convert pressure ratios to both British and SI pressure units. Scale factors

which may be used to compute the distance and time values actually observed under the ambient conditions of each shot are also provided. Dimensional pressure units are used for the results presented at gauge locations.

Unit conversion and scaling factors



For feet scaled to a 1000 lb charge, multiply the top scale by 10.

For time scaled to a 1000 lb charge, multiply time scaled to a 1 kg charge by 8.683.

For pressure in kPa, multiply a pressure ratio (in atmospheres) by 101.325. For pressure in psi, multiply the pressure ratio by 14.696. To convert kPa to psi, divide by 6.895.

To obtain distance values actually observed for Shot 9, in meters, multiply scaled values in this report by 8.111. To obtain the observed distance values in feet, multiply the reported scaled values by 26.611. To obtain observed time values, multiply scaled time values by 8.1069. For observed pressures in kPa, multiply by 93.02; for observed pressures in psi, multiply by 13.49.

PREFACE

The authors gratefully acknowledge the opportunity offered by the Defence Research Establishment Suffield and the Defense Nuclear Agency to participate in the experiments described in this report. The analyses described here were carried out under contract with the Canadian General Electric Company, and with additional financial support from a research grant by the National Research Council (A 2952). The advice and assistance of Mr. A.P. Lambert, C.G.E. Project Officer at DRES, and Mr. J. Keefer, of the Ballistic Research Laboratory, is also gratefully acknowledged.

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LIST OF ILLUSTRATIONS (cont'd)

Footnote:
To assist in the comparison between volumes, similar figures have been numbered identically. For this reason, figures numbers 9, 10 and 11 are not used in this volume.

LIST OF TABLES

Footnote:

To assist in the comparison between volumes, similar tables have been numbered identically. For this reason table number 6 is not used in this volume.

CHAPTER 1, SHOT 9 ANALYSIS

1.1 Introduction

This is the second volume in a series which presents the particle trajectory analysis results from four experiments (Dipole West Shots 8, 9, 10 and 11) carried out to obtain information on the interaction of spherical blast waves with real and ideal reflecting surfaces. A general description of the project can be found in Volume 1. The results presented in this volume are for Shot 9, in which the same charge configuration was used as in Shot 10 (reported in volume 1), but which was carried out over a smoother ground surface. In each experiment, photogrammetrical studies were made of the shock fronts (refractive image analysis, RIA), and of the motions of smoke puff particle tracers (particle trajectory analysis, PTA). The refractive image analysis results were reported by Dewey et al. (1975) and results of the particle trajectory analysis are presented in this report. The method of particle trajectory analysis, common to all four shots is described in detail in Volume 1 only.

1.2 Description of Shot 9

Dipole West Shot 9 was fired on October 22nd, 1973 by the Ballistics Research Laboratories at the Defence Research Establishment Suffield, in Alberta, Canada. Two 1080 lb

(491 kg) spheres of Pentolite were detonated simultaneously, to within 5 microseconds, at nominal charge heights of 15 and 45ft (4.6 and 13.7m) over a relatively smooth ground surface.

Particle trajectory data were gathered by photographing the movement of smoke puffs formed in a vertical plane running out from ground zero at 6.7° south of west. A WF5 camera operating at about 3400 frames per second was positioned 30ft (9.2m) above ground level at a position 600ft (183m) due south of ground zero (GZ), the point on the ground vertically beneath the charges.

Table 1 gives the field survey data for the event, and Figure 1 shows a plan view of the layout. The dashed line represents the approximate line of sight of the WF5 camera. Figure 2 shows the field of view of this camera.

The smoke puff grid was made up of 9 columns of 12 puffs each, hung vertically on strings. The vertical spacing of puffs was 5ft, beginning 3ft above ground level and ending at a height of 58ft. The horizontal spacing of the columns of puffs was 10, 7 or 5ft, depending on the distance from ground zero, beginning at about 25ft and ending at about 85ft from GZ. Of the possible 108 smoke puffs, 106 detonated successfully. A good film record was obtained, except that the detonation zero timing mark was not recorded, which means that the results cannot be related to the detonation pulse to the charges with an accuracy better than ±0.15 ms.

This report describes the analysis of the smoke puff data collected for Shot 9, and presents and discusses some of the results of that analysis.

1.3 Camera calibration and data reduction

The calculated camera position coordinates and orientation angles for Shot 9 are presented in Table 2, together with the positions of photomarkers transformed from one frame of the film just before detonation to an object plane defined as passing through ground zero and being normal to the camera orientation axis. The differences ("shifts") between the object plane positions of the transformed calibration points and their positions computed from the field survey data are given in Table 2. The object plane positions of the calibration points computed in these two ways are also shown in Figure 3.

The camera calibration procedure, described in detail in Volume 1, ensured that selected photomarker images (P1 to P5) transformed to the object plane in a way which matched them exactly to the positions computed using the survey data. These reference photomarkers for Shot 9 are indicated in Figure 3 using large circles: namely, P1 = W1, P2 = W3, and P3 = 300W2. The separation distance between P4 = P3 = 300 WZ and P5 = W2 was also used as a calibration parameter. The probable reasons for the shifts seen for photomarkers VP1A

and VP1B was discussed in Volume 1.

The image positions of two reference photomarkers (VP3B and 300W2) and all smoke puffs were measured frame-by-frame over a time interval corresponding to the approximate duration of the positive phase of the blast waves (film frames 9 to 200), and were transformed to distances in the object plane by matching the reference marker positions to their positions transformed from the calibration frame. These data were again transformed from the object plane to the smoke puff plane which was assumed to pass through "corrected" ground zero; to be vertical, and to run 6.7° south of west from GZ.

The x-y coordinate system in the smoke puff plane was the same for Shot 9 as for Shot 10 except that the corrected value for ground zero was displaced 1.0 ft from the surveyed ground zero, in a direction approximately 46° south of east. The corrected ground zero was defined to have the same elevation as the surveyed ground zero, but was located directly under the midway point between the two charge centers. As for Shot 10, all data in the output plane are plotted with the x coordinate reflected, i.e. with positive values of x to the right hand side, as if the smoke grid had run to the right of the charges rather than to the left as seen in the film images.

A time was assigned to each film frame using the 1 ms timing marks placed on the film during its exposure. The film timing method was described in Volume 1, and the complete

set of film timing data used for Shot 9 is provided in Table 3. In the absence of a zero time pulse on the film, zero time was determined using the static zero calibration distance for the camera plus one-half a frame length. Because the static zero distance is at most a frame length less than the actual zero distance measured from any moving film, the error in frame times can be at most one-half frame (about 0.15 ms).

Figure 4 shows the positions of the 106 detonated smoke puffs at a time prior to the detonation of the two charges. These positions are in the plane of the charges and the smoke puff grid, as described above. The smoke puff plane was not exactly parallel to the camera image and object planes (Figures 2 and 3), and various geometrical corrections were applied to make the transformation between them. The puffs enclosed in parentheses were not visible in the earlier film frames, but were seen later when they were illuminated by the light of the fireball. Charge positions in the figures are plotted as if they were positioned exactly above the corrected ground zero origin. The data shown in Figure 4 have not been scaled.

1.4 Data scaling and trajectory fitting

The position-time histories of individual smoke puffs were extracted from the frame-by-frame positions of the smoke puff grid, and then scaled to standard atmospheric conditions

and charge weight. A change to SI units was made at this point in the analysis. The resulting trajectories were edited, and then smoothed by fitting polynomial functions.

Particle trajectory data were scaled by dividing all distances by Sachs scaling factor $S = \sqrt[3]{(WP_o)/(W_oP)}$ and multiplying all times by the factor $C/(C_oS)$, where C is the ambient sound speed computed for Shot 9. Data used to compute C and S, and define the scaled event, are listed below with the computed values of C and S.

Ambient temperature,	T = 14.17 °C	(57.5 °F)
Ambient pressure,	P = 93.02 kPa	(13.491 PSI)
Relative humidity,	RH = 55.0%	
Computed vapour pressure,	VP = 0.89 kpa	(6.7 mm Hg)
Ambient sound speed,	C = 340.469 m/s	(1117 ft/s)
Charge weight,	W = 489.9 kg	(1080 lbs)
Sachs scaling factor,	S = 8.1111	
Standard charge weight,	W_o = 1.0 kg	(2.2 lbs)
Standard pressure,	P_o = 101.325 kpa	(14.7 PSI)
Standard temperature	T_o = 15 °C	(59 °F)
Standard sound speed, (dry air)	C_o = 340.292 m/s	(1116 ft/s)

The results presented in this report therefore apply to a scaled event which is the detonation of two 1 kg charges in a standard atmosphere. The scaled heights of burst for Shot 9 were 0.571 m and 1.707 m, and the charge separation divided by two, scaled, was 0.568 m. These figures may be compared to the scaled charge height and half-separation distances for Shot 10 which were 0.563 and 0.575 m respectively.

Figure 5 shows the scaled particle trajectory data for Shot 9 in the smoke puff plane with positions measured horizontally and vertically from corrected ground zero. Approximately 9350 puff positions are represented. As represented, the raw trajectory data have not been smoothed.

The raw particle trajectory data were edited to remove obvious data processing errors, such as a single point widely displaced from its trajectory for one or two frames. The trajectory of each puff in turn was then smoothed by least squares fitting simple polynomial expressions separately to both the x and y coordinate data, these being discrete functions of frame time. The adequacy of each fit was determined by examining on the same graphical output, plots of both the raw trajectory data and the fitted curve. For Shot 9 this meant examining and adjusting 212 such plots, at least two or three times each.

For a given puff, the first step in fitting the raw trajectory data was to set the time of arrival of the shock front first hitting the puff. The data at subsequent times were fitted with polynomial functions, as described in Volume 1, paragraph 2.5. The first derivatives of the fitted functions were also calculated at a series of times for use in later calculations of particle velocity.

1.5 Regionalization and shock strength calculations

Five regions were defined in the smoke puff plane on the basis of the shock front which first struck the puffs in a particular region. These are shown in Figure 6. The regions were bounded by the triple point trajectories measured using refractive image analysis (Dewey et al., 1975). Regions 1 and 2 are those in which the smoke puffs were first hit by a spherical primary shock front, and regions 3, 4, and 5 are those in which the puffs were first hit by a Mach stem.

In each of the five regions, the shock trajectory data obtained from the first movement of the smoke puffs were fitted to a function of the form

$$r(t) = A + Bt + C \log (1 + t) ,$$

where r is the shock radius, t is the time after detonation, and A, B, and C are the fitted coefficients. The shock velocities were calculated by differentiating this function.

The peak particle velocity, V_s , peak density, D_s , and peak hydrostatic overpressure, P_s , as functions of shock radius in each of the five regions, were calculated from the shock velocity using extensions of the Rankine-Hugoniot equation. Details of the shock radius calculations etc. are described in Volume 1, paragraph 2.6.

1.6 Particle velocity calculations

Particle velocities were computed using the methods described in Volume 1, paragraph 2.7.

1.7 Density and hydrostatic overpressure calculations

Densities and hydrostatic overpressures in the smoke puff plane were calculated by the method described in Volume 1, paragraph 2.8. Results in both cases represent average values over cells defined by four adjacent smoke puffs.

1.8 Surface representation

Surfaces were fitted to the times of shock front arrival and to the fields of particle velocity, density and hydrostatic overpressure at a sequence of times. All data were interpolated onto a common regular Euleurian grid. Fields of dynamic pressure were computed from surface-interpolated particle velocity and density results. Contour plots were generated for all surfaces at selected times, and time histories computed at several fixed locations. The methods used were identical to those described for Shot 10 in Volume 1, Chapter 3.

CHAPTER 2. SHOT 9 RESULTS

2.1 Times of shock front arrival

The measured initial puff positions, the times of first shock arrival, and the peak particle velocities obtained by differentiating the functions fitted to the particle trajectories are presented in Table 4. Puff position is given relative to corrected ground zero as origin with horizontal and vertical axes. Puff position and the time of arrival of the first shock are given both as observed and scaled. Particle velocities listed are derivatives of the fitted puff trajectories at the times of shock arrival, and are expressed in Mach units. Expressed this way, the particle velocities are the same scaled as unscaled. Also listed are the initial radial puff positions (scaled) and region codes.

Shock front data determined from the first movement of the smoke puffs, i.e. calculated from the time-of-arrival data in Table 4, are listed in Tables 5.1 - 5.5. Each table corresponds to one of the 5 regions used. Listed are the observed and fitted unscaled shock trajectory data, the scaled fitted shock trajectory data, and the computed shock velocities and peak parameters associated with shock strength: peak hydrostatic overpressure in atmospheres and in kilopascals, peak particle velocities in Mach units, and

peak density ratios. Given as ratios, these peak parameters are the same scaled as unscaled. Pressure given in kilopascals in the tables refers to the unscaled (observed) case only.

The shock front radius versus time data derived using particle trajectory analysis (PTA) are also shown in Figures 7.1 - 7.3 for the two primary fronts, the two Mach stems at the interaction plane, and the ground Mach stem, respectively. They are compared to corresponding data derived from refractive image analysis (RIA) reported by Dewey et al (1975). The refractive image analysis results were obtained using photogrammetry against a striped canvas backdrop and they describe the shock as it travelled in a direction almost diametrically opposite to the direction of the smoke puff grid.

2.2 Shock strengths

Peak particle velocities calculated from shock front velocities are shown in Figure 8.1 - 8.3 for the primary fronts, interaction Mach stems, and the ground Mach stem. This method of determining peak particle velocities has been labelled method 1, and the data plotted correspond to those listed in Tables 5.1 - 5.5. The results in the figures are compared with those previously obtained using refractive image analysis (RIA). In the case of the primary shock fronts, results are also compared to those of Brode (1957) for TNT.

In Volume 1 other methods of determining shock strengths in the various regions were described. It was demonstrated that method 1 was clearly the most accurate, and in the present volume shock strengths calculated using methods 2 and 3 are not reported. For this reason Figures 9, 10 and 11 and Table 6 do not appear in this volume.

2.3 Particle velocity fields

The calculated particle velocities in the plane of the smoke puffs are shown as vectors in Figures 12.1 through 12.7, for various times after the detonation. All times and positions are scaled to a 1 kg charge in a standard atmosphere. The particle velocity vectors represent the derivatives of the smoothed particle trajectories, and their magnitudes may be judged using the standard vector shown on each figure. All velocites are measured in Mach units, relative to the standard sound speed. Puffs not yet struck by a shock wave are represented by small circles (zero velocity).

Numerical data corresponding to Figures 12.1 - 12.7 are listed in Tables 7.1 through 7.6, along with scaled radial positions of the puffs, and region codes as defined in Figure 6. Conversion factors are given at the foot of each table, which may be used to convert the scaled data in the tables and figures back to their original unscaled values.

2.4 Density and hydrostatic overpressure fields

Calculated average relative densities throughout the smoke puff plane are depicted graphically in Figures 13.1 - 13.4, for various times after the detonation. All time values are scaled. Cell positions are scaled and are given relative to the corrected ground zero as origin with horizontal and vertical axes. The calculated densities may be judged using the density shading scale shown on each figure. Density is given as a ratio, relative to ambient density. Cells not yet struck by a shock wave and cells in which the density has dropped to a value less than ambient density are shown blank.

Corresponding numerical data are listed in Tables 8.1 - 8.3 along with radial cell positions computed according to the regions defined previously. Numerical data describing the fields of hydrostatic overpressure are similarly listed in Tables 9.1 - 9.3. The pressure results for a given cell were obtained by multiplying the density results for that cell by a factor determined by the strength of the shock which first traversed the cell and which then remained constant, i.e. by assuming isentropic flow after the first shock.

2.5 Times-of-arrival surface

Figure 14 shows a perspective view of the surface fitted to the original smoke puff positions and the observed times of first shock front arrival, i.e., to the data listed in

Table 4. The grid mesh size is 0.1 by 0.1 meters (scaled), about 2.5 feet square (unscaled), or about ½ that of the original smoke puff grid. The charge positions are indicated on the vertical distance axis.

The times-of-arrival surface is smooth enough to permit contouring, the contours in this case (isochrones) representing shock front shapes at different times, as shown in Figure 15, but the surface is not smooth enough to permit the calculation of gradient vectors which could be used to compute shock velocity vectors and shock strengths over the new grid.

Two attempts were made to obtain contours of shock strength. In the first, the times-of-arrival surface was smoothed by least-squares fitting low-order, one-dimensional polynomial functions to the time-of-arrival data along each grid row and column separately, and computing the derivatives of the fitted functions to obtain the associated components of the surface gradient vectors. Shock velocity vectors were obtained from the time-of-arrival gradients, and from these peak particle velocities were computed. The peak particle velocity (shock strength) surface is shown in Figure 16. The contours of this surface (not shown) did not exhibit any discontinuities across the boundaries of the shock front regions, as they would if surfaces were fitted to the time of arrival in each region separately.

The results of a second method used to compute shock strength contours are shown in Figure 17. These were obtained by interpolating shock radius at each value of peak particle velocity shown, for each shock front region in turn, using the peak particle velocity versus radius curves shown in Figure 8. Arcs of circles with these radii, centered on the appropriate points along the vertical charge axis, were then drawn in the regions to represent shock strength contours. These peak value contours are discontinuous across triple point locii and other region boundaries. As a result, some horizontal lines are crossed twice by the same contour or, in other words, identical shock strengths can be found at two locations the same vertical distance from a reflecting surface, but at different radial distances from the vertical charge axis.

2.6 Field surface contours

Contours of equal particle velocity, density, hydrostatic overpressure, and dynamic pressure in the blast waves were determined for a series of times, using surfaces fitted to the various measured data fields at those times. Sample results are shown in Figures18 through 21 at scaled times of 2.5 ms and 4.0 ms. The shock fronts shown in these figures are obtained from the time-of-arrival surface (as were those in Figure 15). Field contours such as those shown can be drawn for any scaled time between 0.5 ms and 7.0 ms.

It should be re-stated that all of these results were obtained from the photography of the smoke puffs only and do not rely on the results obtained using the refractive image analysis (Dewey et al., 1975).

2.7 Time histories

By mapping the physical properties of the blast waves at short time intervals it was possible to determine the time histories of these properties at any selected fixed position within the smoke puff grid. This was done at 12 fixed locations, three in the two primary regions and three in each of the three Mach stem regions, as shown in Figure 22. At each distance from the axis of the charges in the Mach stem regions, each of the time history stations is the same distance from either the interaction plane or the ground plane. Particle velocity time histories could be interpolated closest to the ground level because these were measured at puff locations, whereas the density and pressure data were measured at cell centers.

Time histories of particle velocity, density, hydrostatic and dynamic overpressure at these locations are given in Figures23 to 26.

Also plotted with the time histories are the interpolated values of the time of arrival of the first shock front at the stations. The height of this time-of-arrival line represents a peak value derived from the shock velocity analysis.

Time histories for hydrostatic and dynamic pressure are also plotted in Figure 27.1 to 27.7 for stations at the nominal positions of field-mounted pressure gauges on the "60 foot gun barrel". The gauges on this gun barrel were mounted at nominal elevations of 10, 15, 20, 27, 30, 33, and 40 feet. The time histories at these locations are given in unscaled units in order to facilitate comparisons with the gauge measurements.

The dynamic pressures plotted in figures 26 and 27 are maximum values, computed using both the x and y components of particle velocity. Similar plots were made of the horizontal components of dynamic pressure, but the differences were not significant since the y components of particle velocity at these locations were small. Other locations could have been chosen at which the y components would not have been insignificant.

CHAPTER 3, DISCUSSION

3.1 Particle trajectory analysis, Shot 9

The methods used to analyze the smoke puff trajectories on Shot 9 were identical to those used for Shot 10 and described in detail in Volume 1 of this report. However, the results for Shot 10 clearly indicated the superiority of one of several methods of analyzing shock strength, and only the results of the superior method were reported for Shot 9.

The rate of smoke puff failure was greater for Shot 9 than for Shot 10 (there were no failures for Shot 10), but the incompleteness of the Shot 9 particle trajectory grid did not greatly interfere with the analysis of the blast wave within the smoke puff region. The extra interpolation required for Shot 9, however, will undoubtedly correspond to some slight decrease in the accuracy of the calculated blast parameters compared with those for Shot 10.

3.2 Primary shock strength of upper charge

The refractive image analysis of the shock fronts described by Dewey et al, 1975 did not provide any information about the primary spherical shocks from the upper charges, and it was assumed that these charges had detonated satisfactorily. This assumption has now been validated for Shot 9 by the analysis of the particle trajectory time-of-arrival measurements.

In Figure 7.1 the shock radii are plotted versus time for the upper and lower charges, and the two curves appear to be identical. Unfortunately, the relatively small charge separation in this experiment made it impossible to observe the primary shocks over a sufficient distance to calculate accurately the variation of shock strength with distance. The limited results which were obtained for shock strength versus distance are plotted in Figure 8.1, compared to Brode's (1957) calculations.

3.3 Comparison of Mach shocks over different surfaces

The refractive image analysis (Dewey et al, 1975) has shown what appears to be a significant difference between the strengths of the Mach shocks over the smooth ground and beneath the interaction plane between the two charges. The results of the particle trajectory analysis given in Figures 8.2 and 8.3 do not indicate the same difference. However, in the RIA case measurements were made as close as possible to the reflecting surfaces, 0.5m above the ground plane and 0.2 m below the interaction plane, whereas in the PTA case the results represent an average of measurements made at puff positions which were not so close to those surfaces, at heights ranging between 1.0 and 4.5 m. The results shown in Figures 8.2 and 8.3 therefore merely indicate that the difference in shock strength over the

ground compared with that at the interaction plane may be dependent on the height above the ground at which the measurements are made - not an unexpected result. Determination of Mach shock strength from measurements made at various heights is also made difficult because an assumption must be made about the exact shape of the Mach shock front, in order to correctly assign shock radius values to smoke puffs in the PTA case. At or near a reflecting surface the problem of shape is not so important. Details of the problem in the PTA case and the manner in which the problem was dealt with for Shots 9 and 10 are described in Volume 1 of this report.

3.4 Resolution of time histories

The time histories of density and pressure shown in Figures 24 and 25 do not always show a sharp rise at the time of shock front arrival. This slow rising is not a real effect but one inherent to the method of particle trajectory analysis, which does not permit a high resolution of density in space or in time. The finite spacing of the smoke puffs does not permit the average density of the air within a rectangular cell defined by four smoke puffs to be calculated accurately until the shock has completely traversed the cell. (The time of complete traversal may be as much as 5 ms.)

For the same reason the calculated time histories often anticipate the time of shock front arrival or, in other words, because a cell lies partly in front of the shock front during the time of traversal, the value of average density calculated at a point ahead of the shock may rise before the arrival of the shock. Also for the above reason, time histories calculated by the particle trajectory analysis method do not resolve any weaker shocks subsequent to the first, although these shocks may be detected occasionally in the calculated histories as a rounded bump in the normally exponentially decaying curve. Efforts are being made to see if this resolution can be improved.

The lack of resolution close to the shock front does not occur in the case of particle velocity, which can be measured with reasonable accuracy as soon as the shock has traversed the relatively small space represented by an individual smoke puff. This effect of improved resolution is manifested also in the dynamic pressure histories since although this parameter depends on measured density, it also depends on particle velocity squared. The squared term is able to exert the greater influence.

In the subsequent volume of this report hydrostatic overpressure and total head pressure histories determined from the particle trajectory analysis will be compared

directly with gauge measurements. The total head pressure will be calculated from the dynamic pressure using appropriate compressibility corrections. Pressure impulse curves will be included.

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Dewey, J.M. 1971. Proc. Roy. Soc. Lond. A324, 275-299.

Dewey, J.M. 1964. Proc. Roy. Soc. Lond. A279, 366-385.

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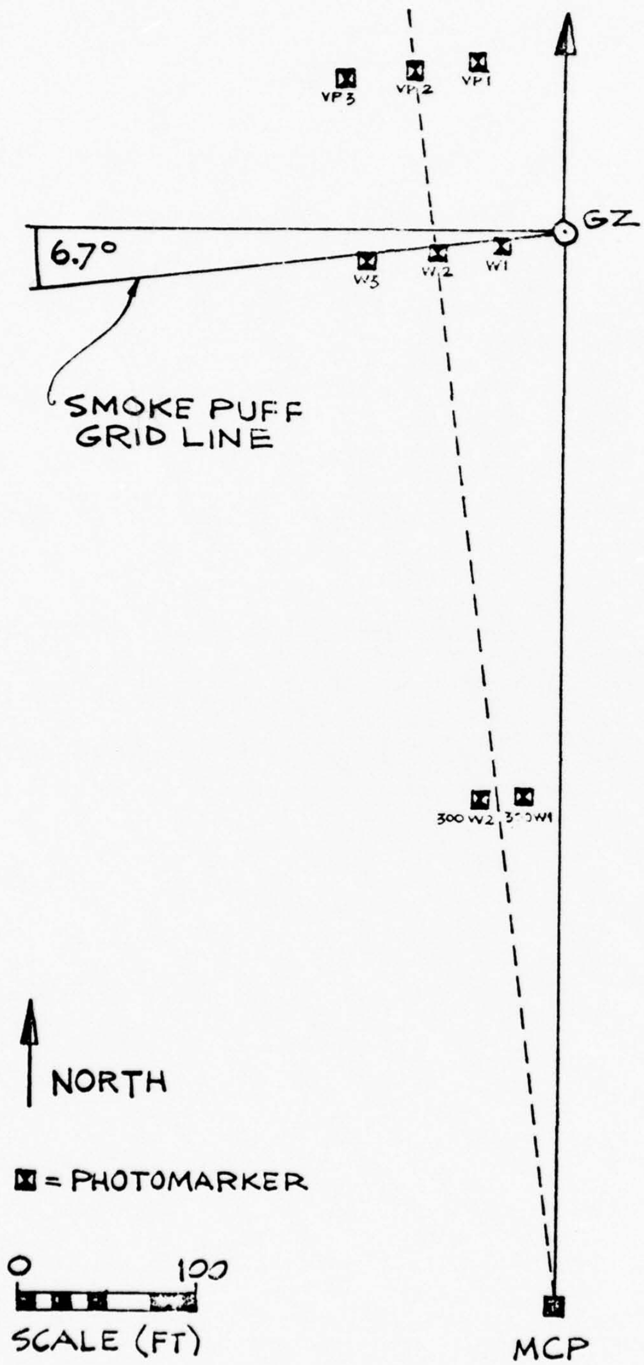


Fig. 1. Plan view of test site, Dipole West/9

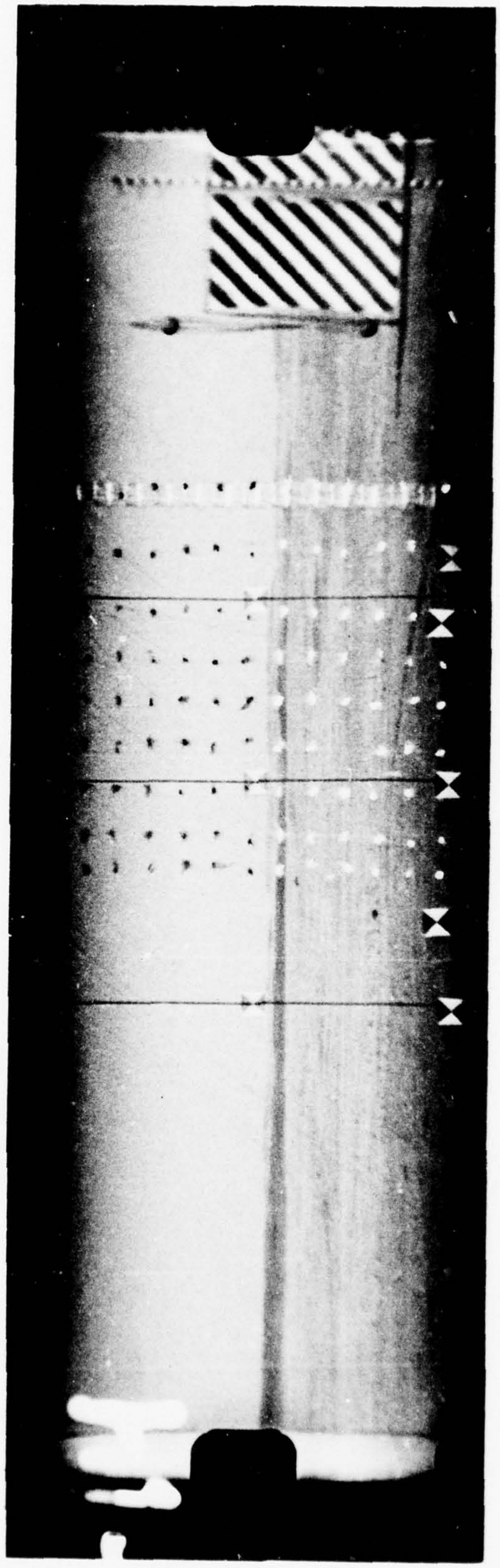


Fig. 2. Field of view of camera, Dipole West/9

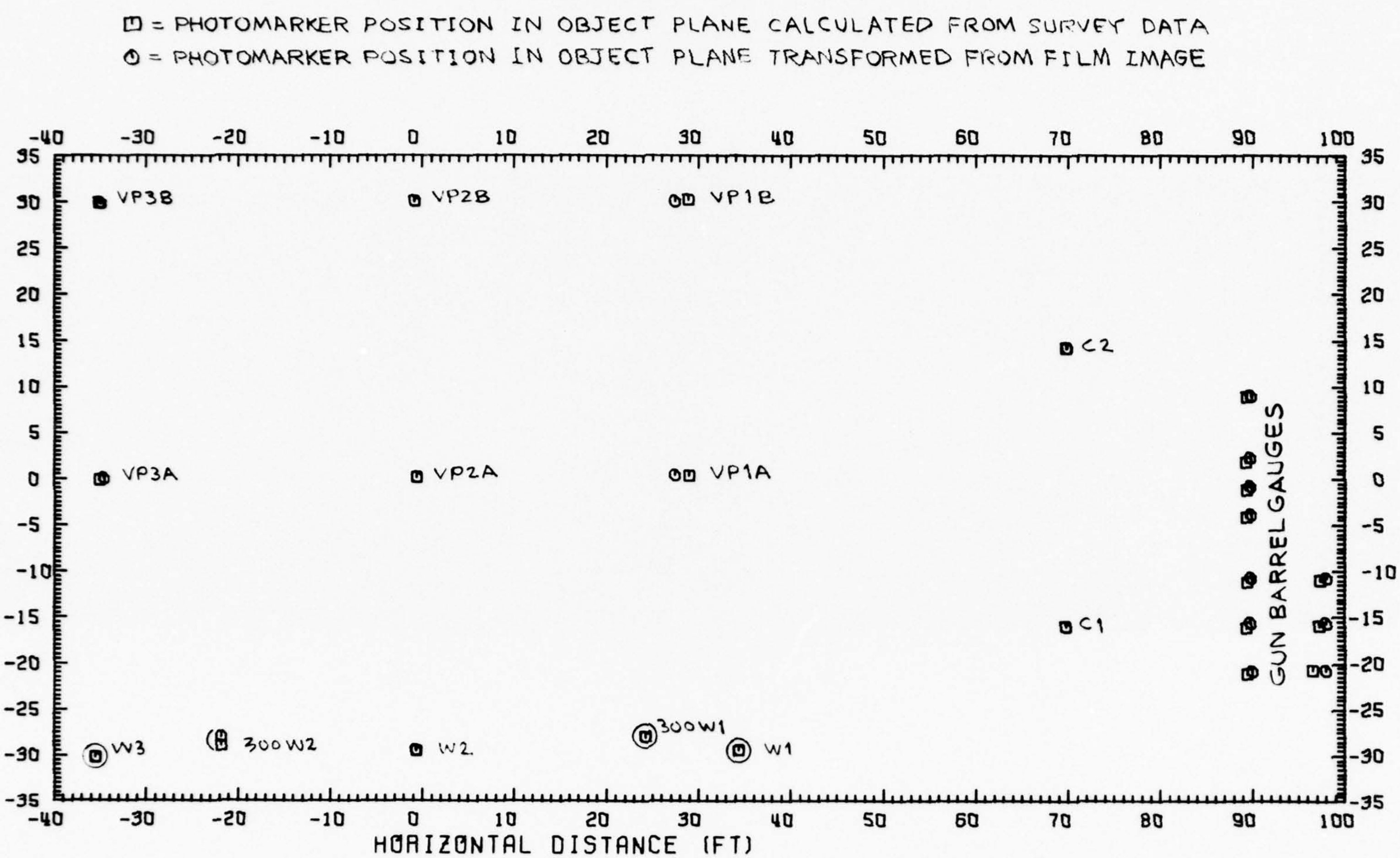


Fig. 3 CAMERA CALIBRATION, DIPOLE WEST/9

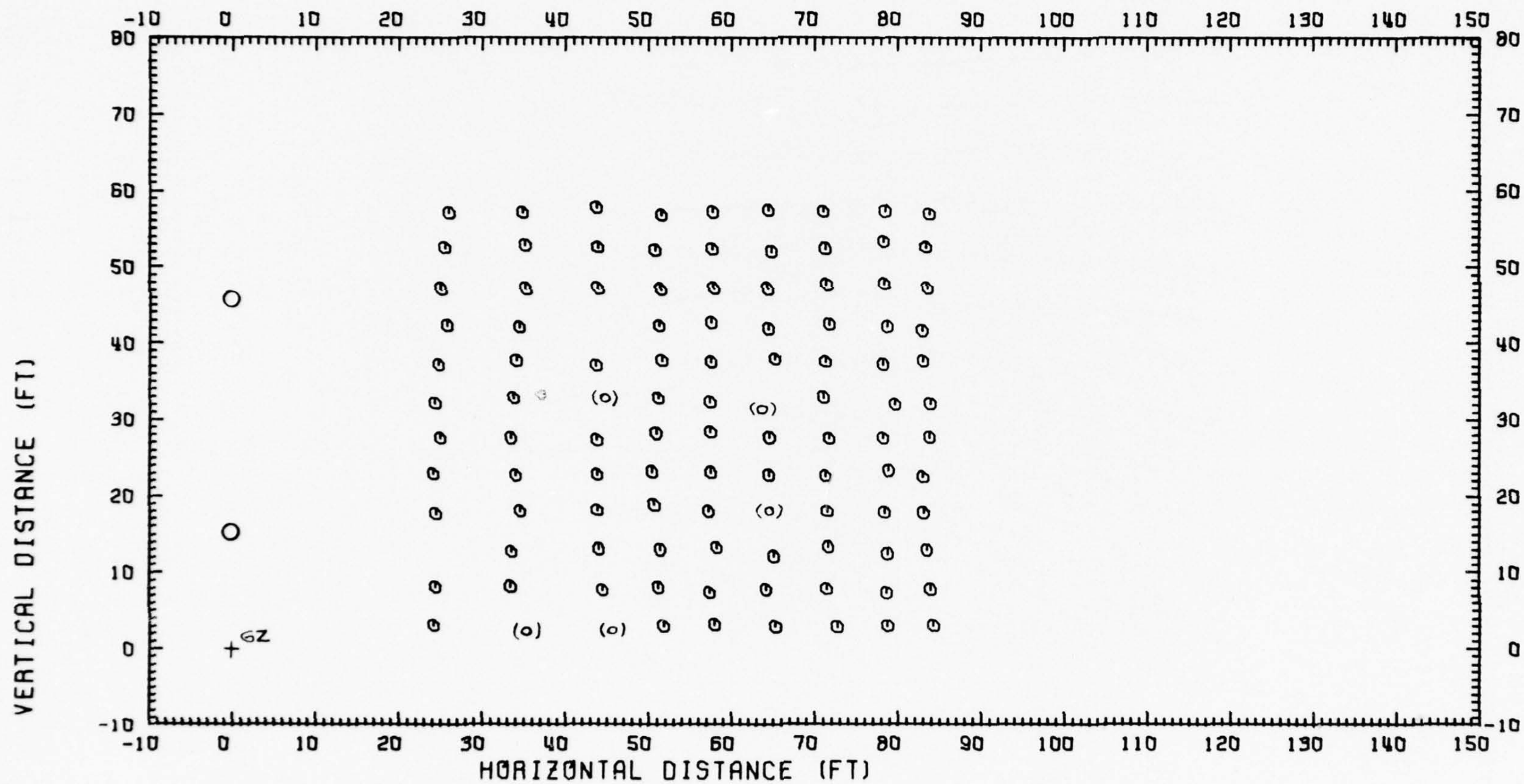


Fig. 4 SMOKE PUFF GRID, DIPOLE WEST/9

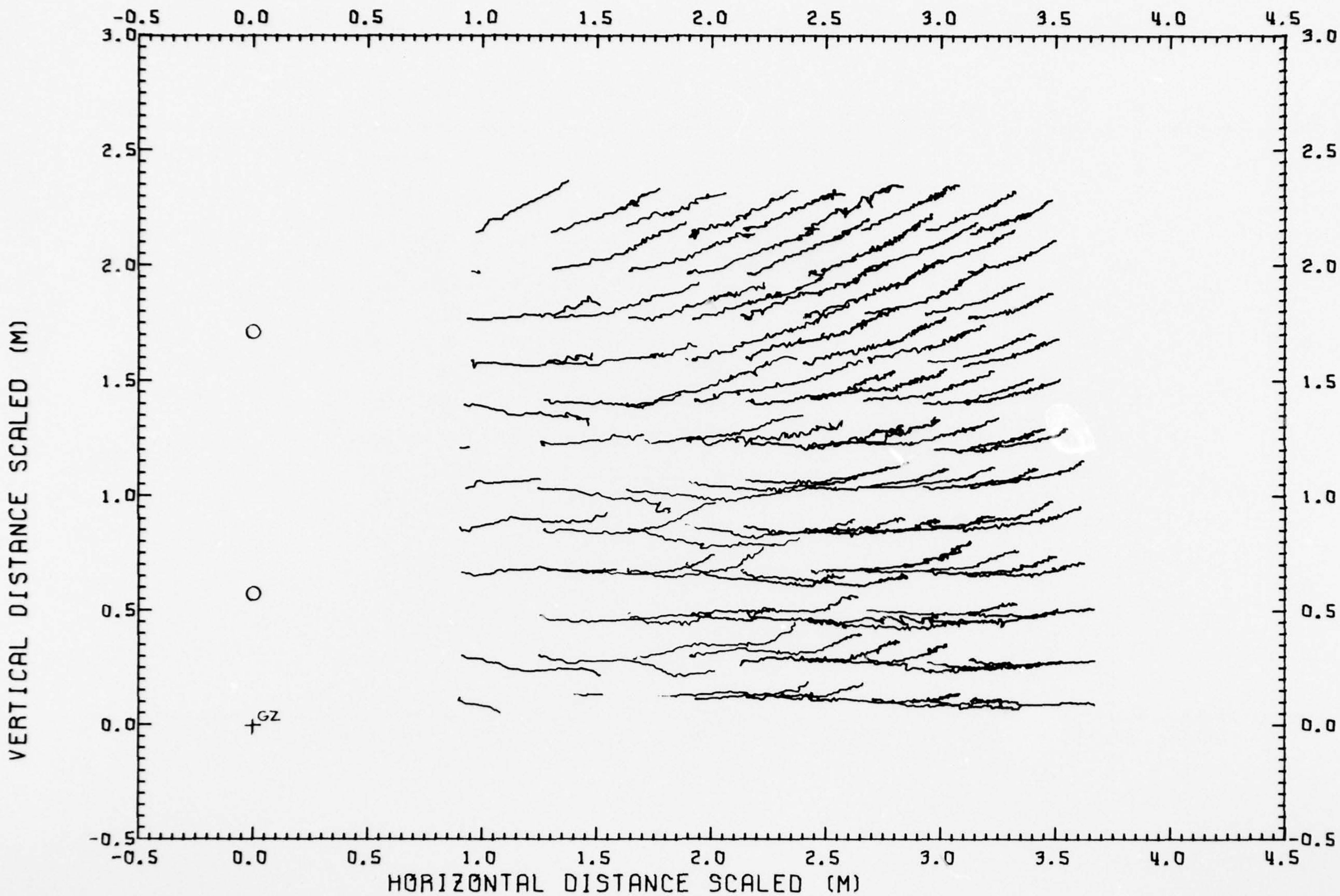


Fig. 5 PARTICLE TRAJECTORIES, DIPOLE WEST/9

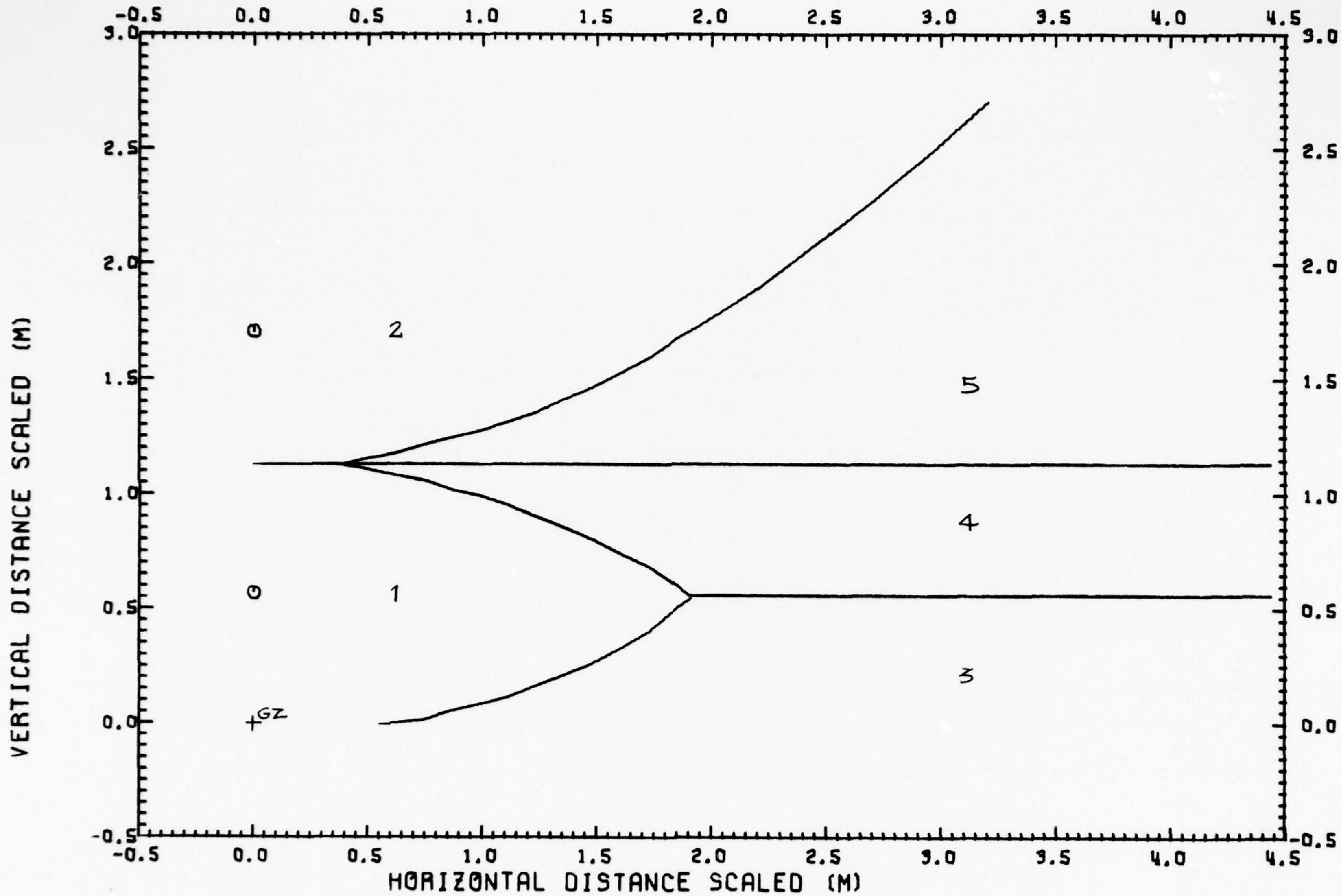


Fig. 6 REGIONS DEFINITION, DIPOLE WEST/9

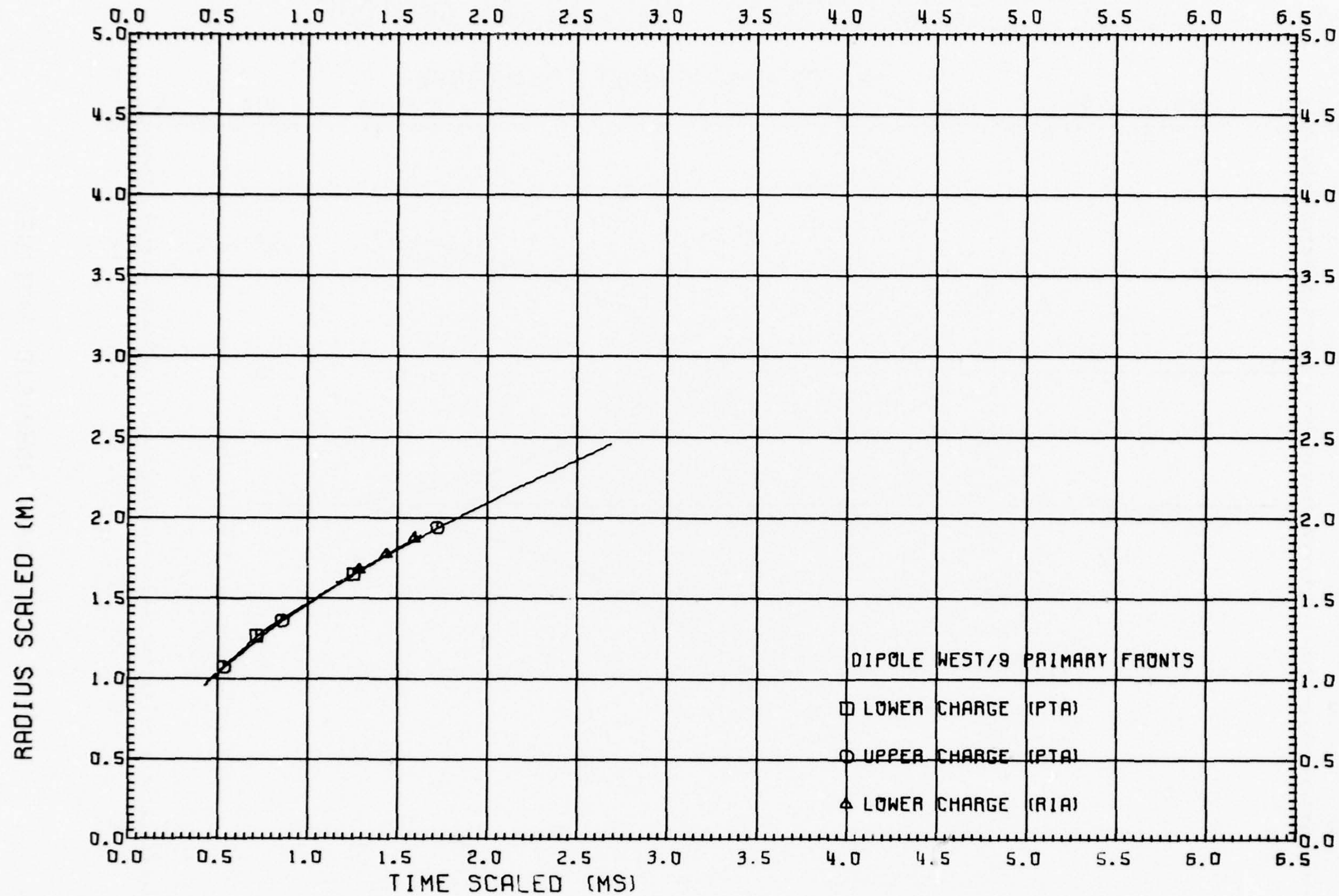


Fig. 7.1 SHOCK TRAJECTORIES, DIPOLE WEST/9

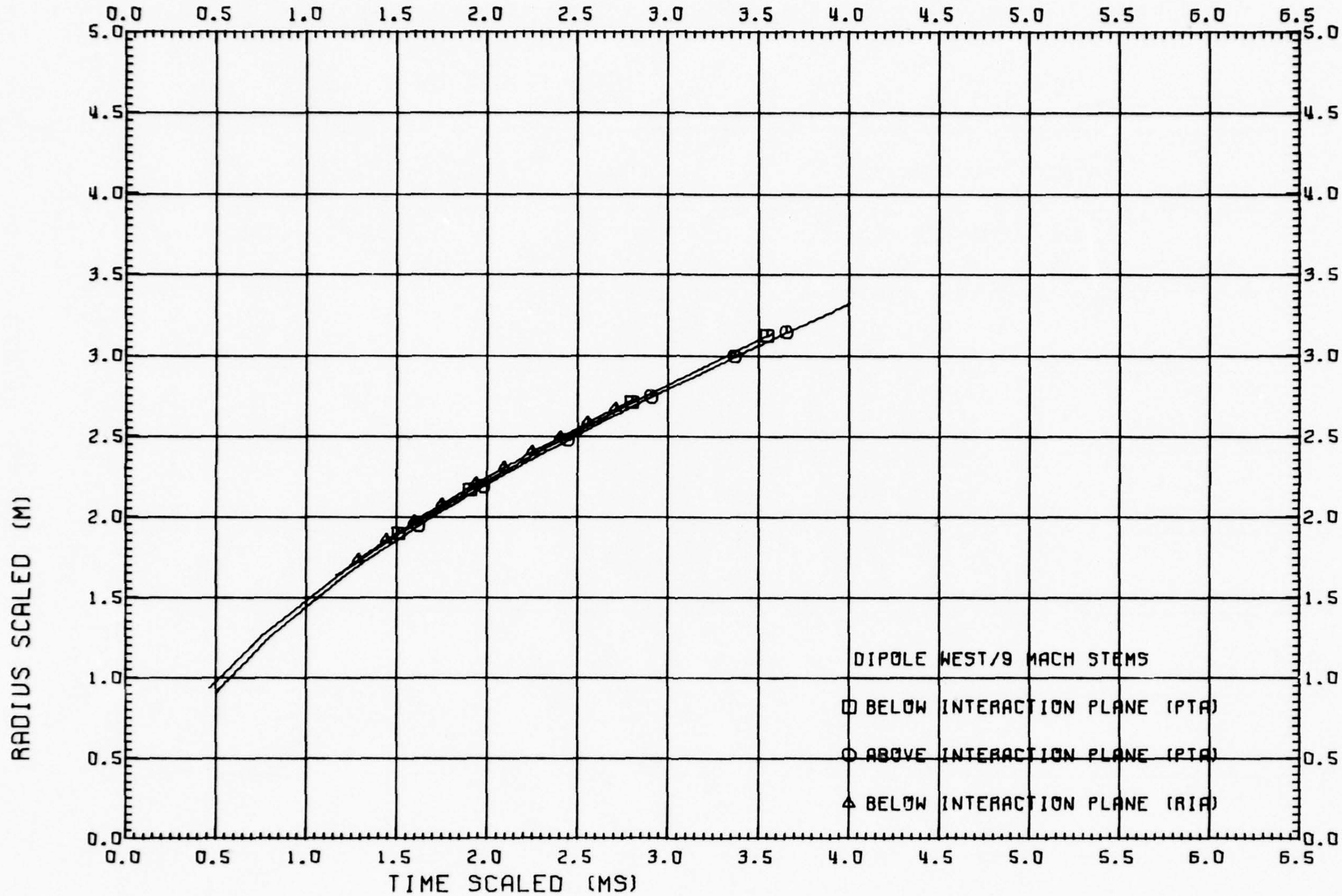


Fig. 7.2 SHOCK TRAJECTORIES, DIPOLE WEST/9

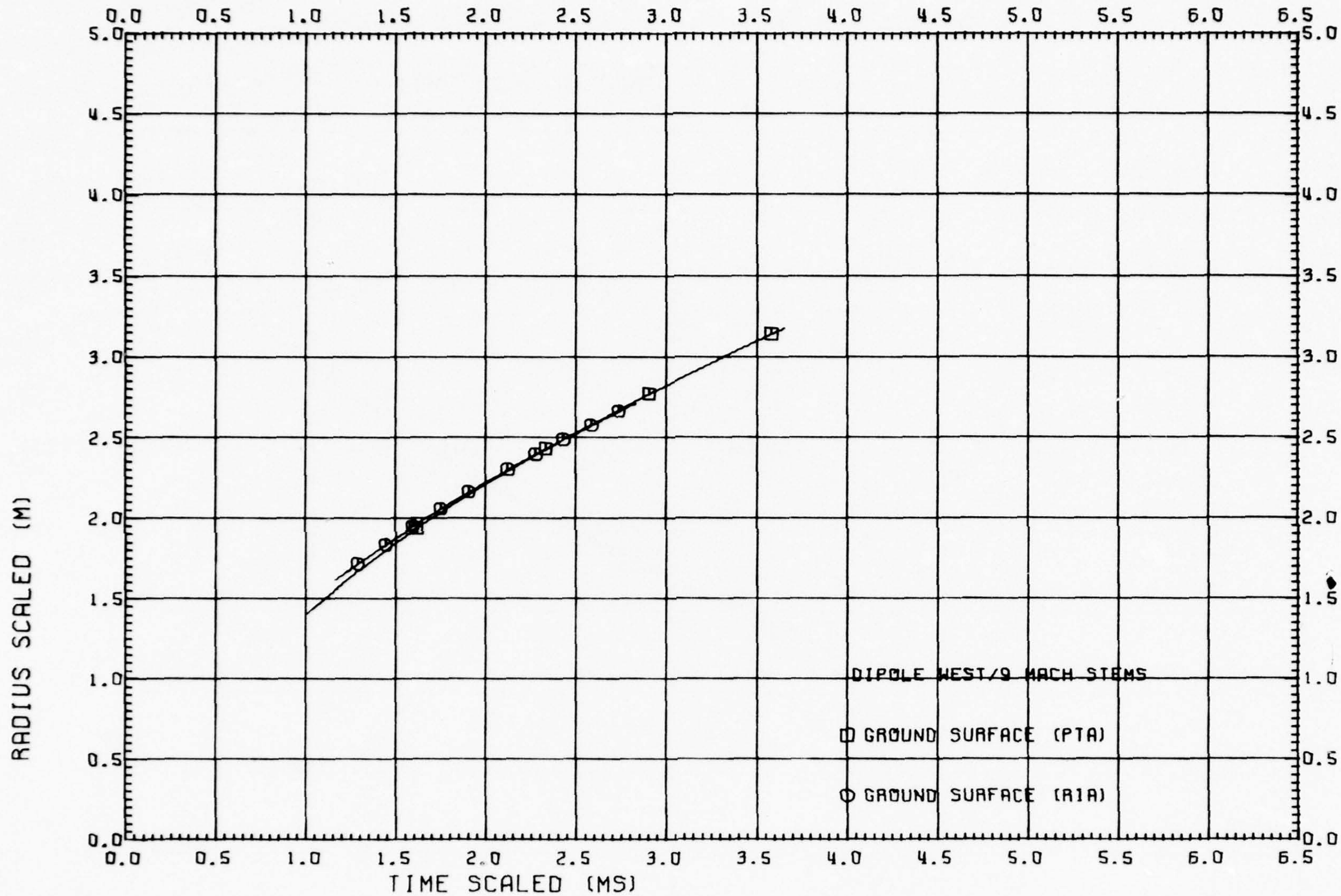


Fig. 7.3 SHOCK TRAJECTORIES, DIPOLE WEST/9

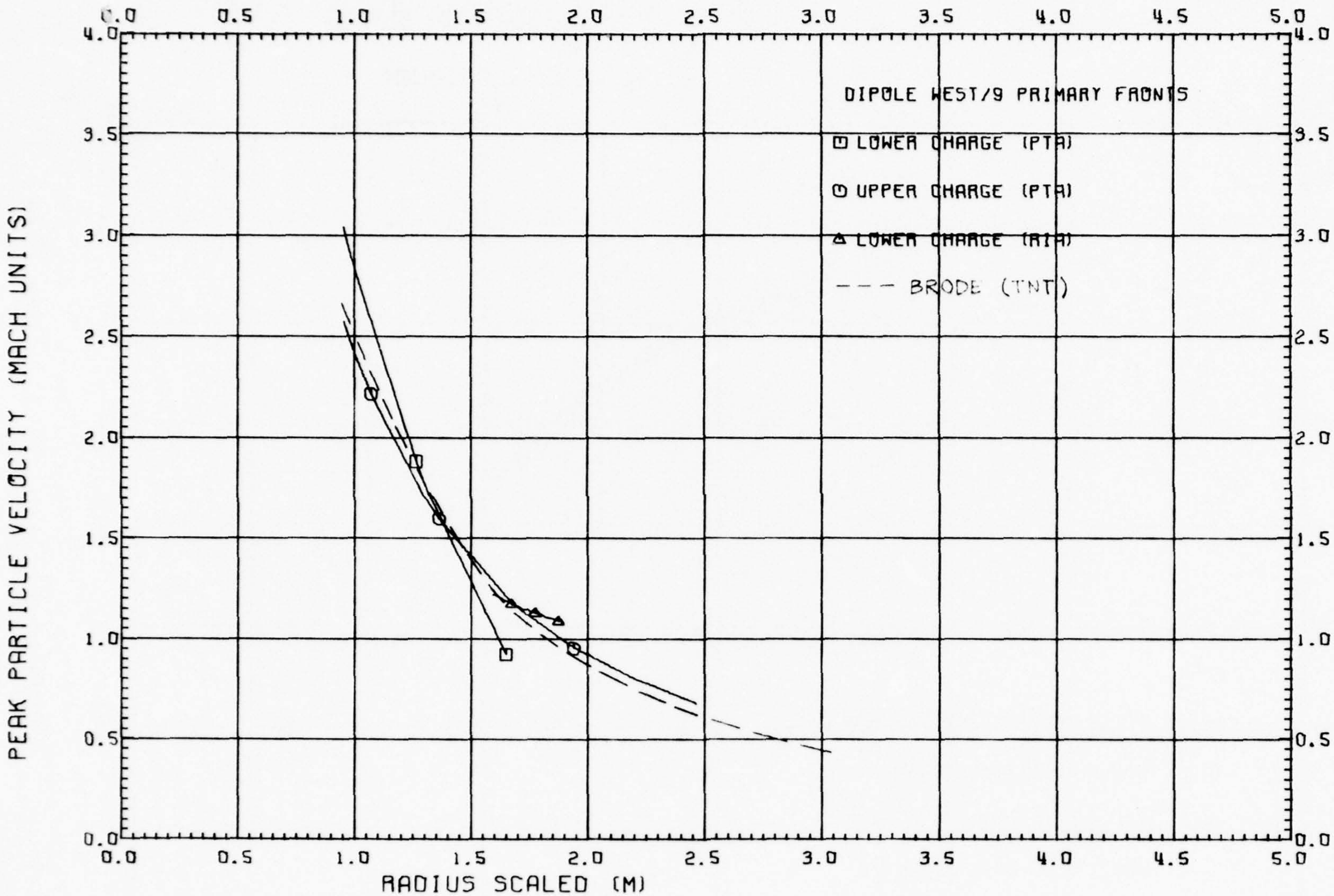


Fig. 8.1 SHOCK STRENGTH, METHOD 1

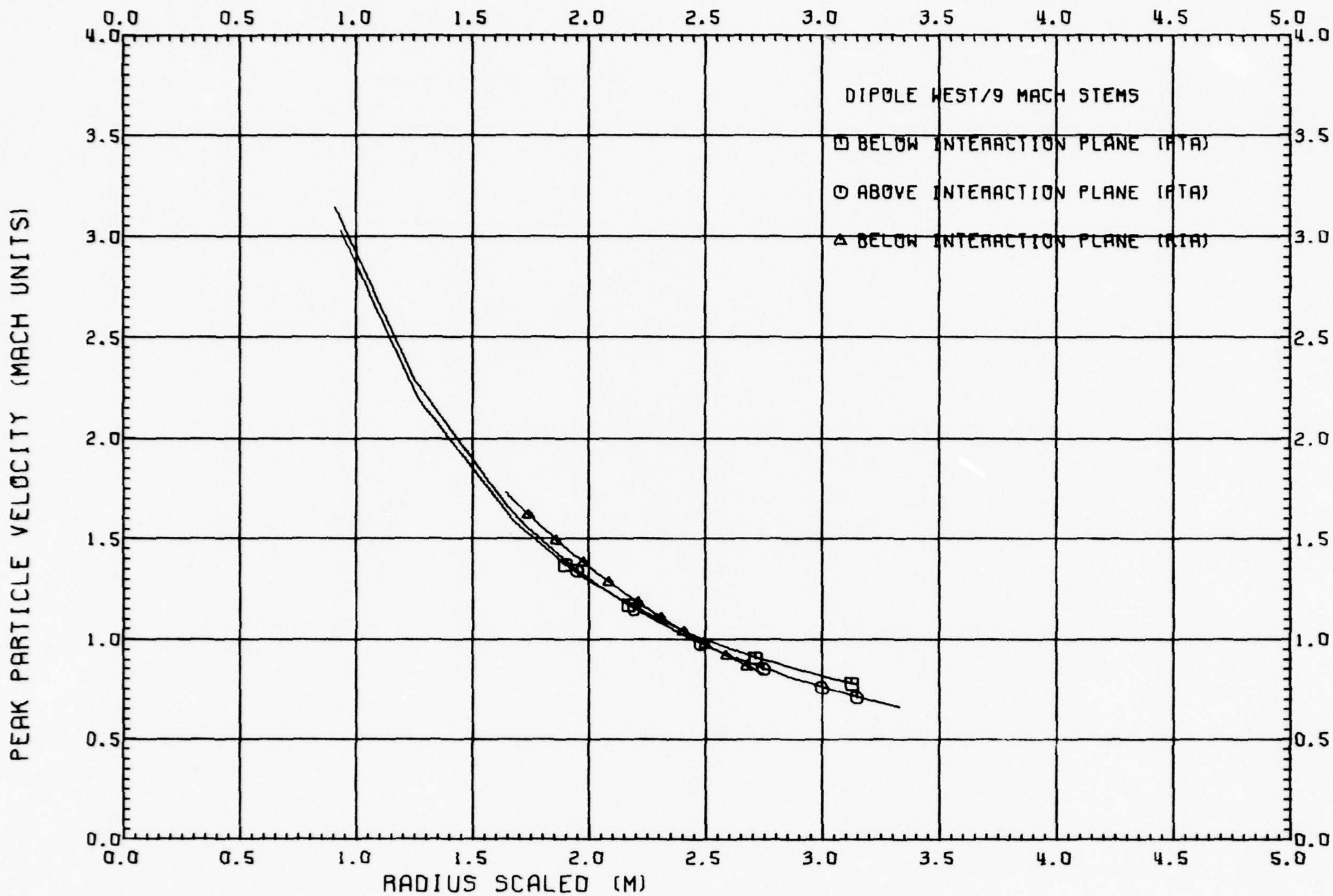


Fig. 8.2 SHOCK STRENGTH, METHOD 1

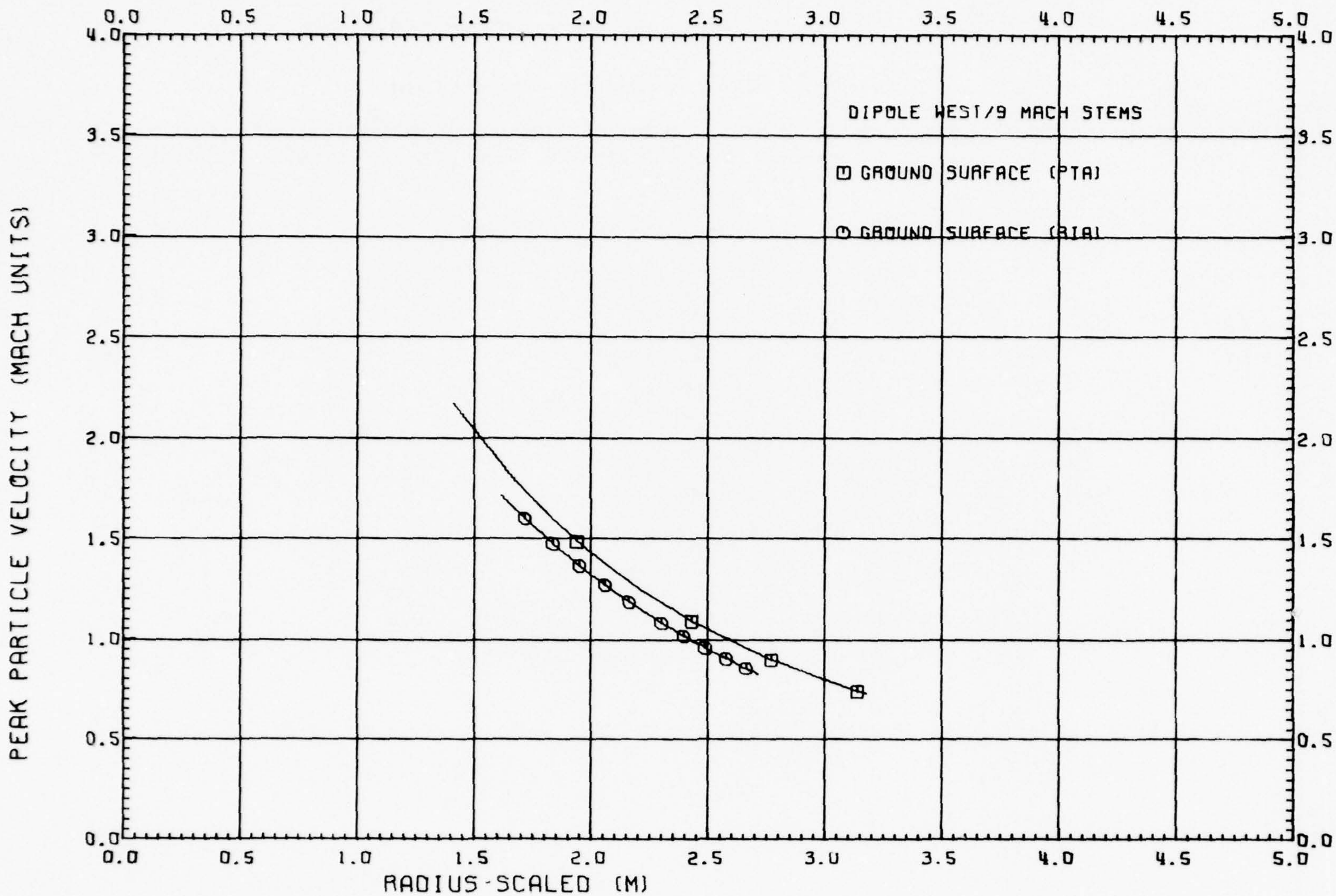


Fig. 8.3 SHOCK STRENGTH, METHOD 1

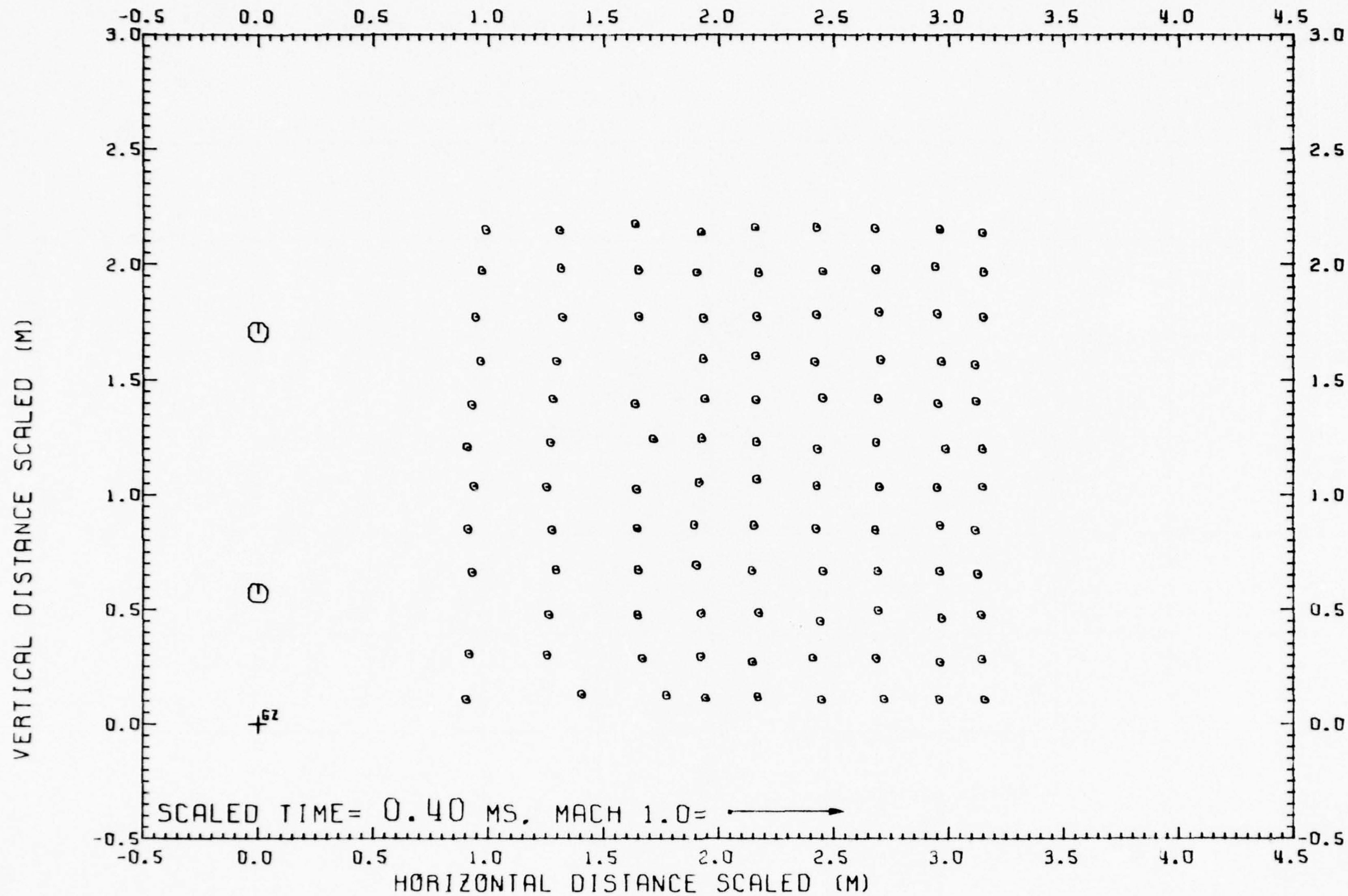


Fig. 12.1 PARTICLE VELOCITY FIELD, DIPOLE WEST/9

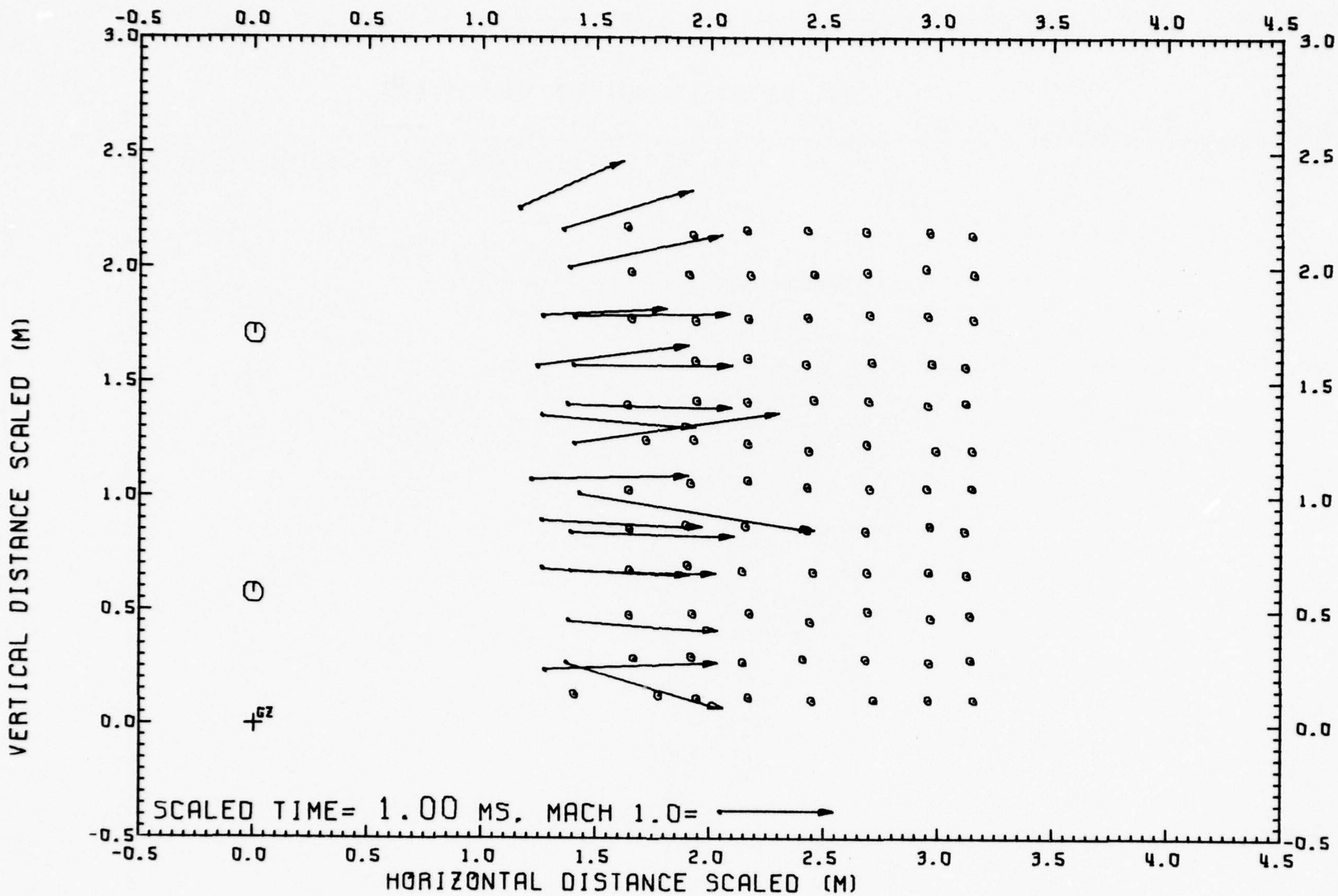


Fig. 12.2 PARTICLE VELOCITY FIELD, DIPOLE WEST/9

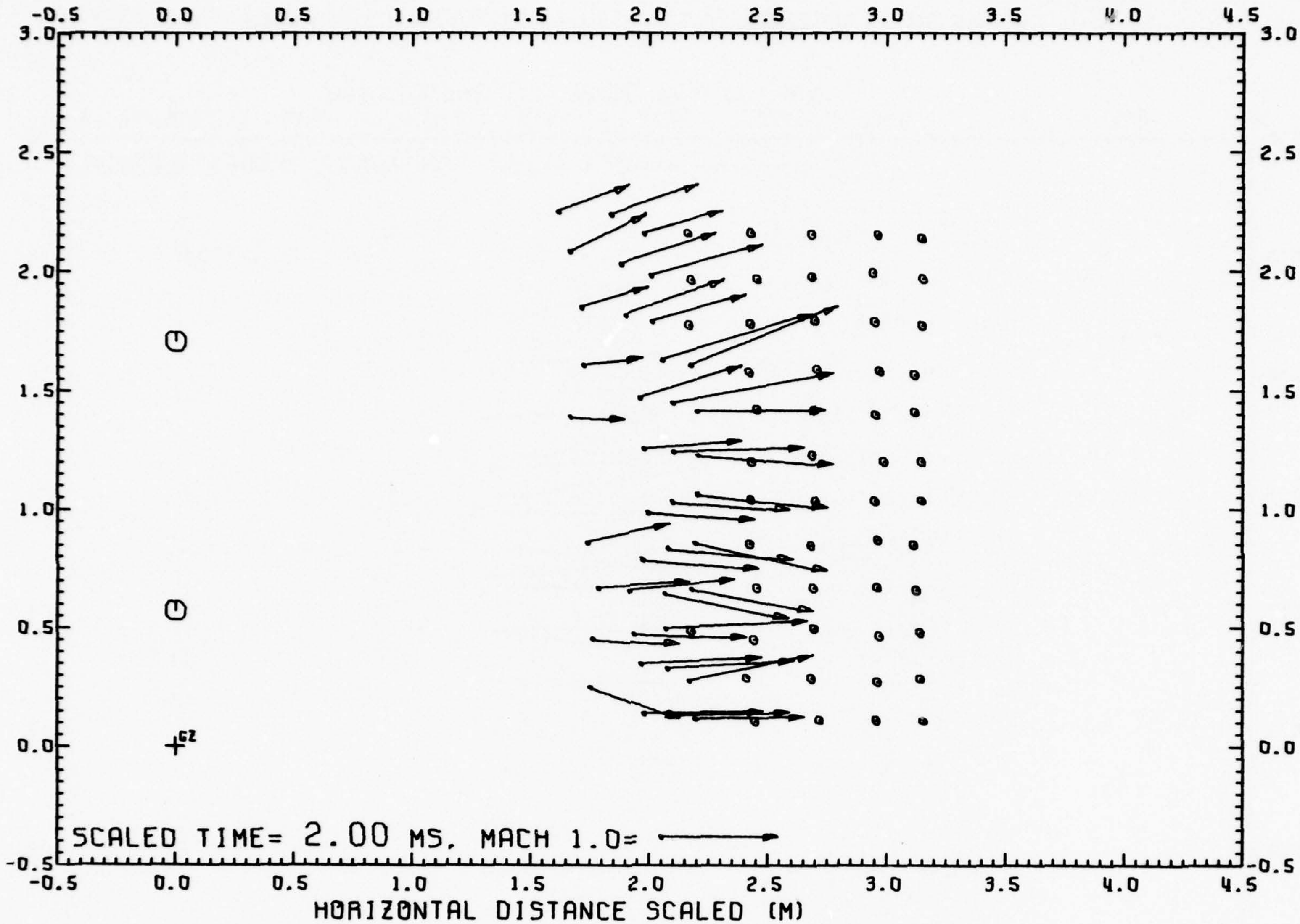


Fig. 12.3 PARTICLE VELOCITY FIELD, DIPOLE WEST/9

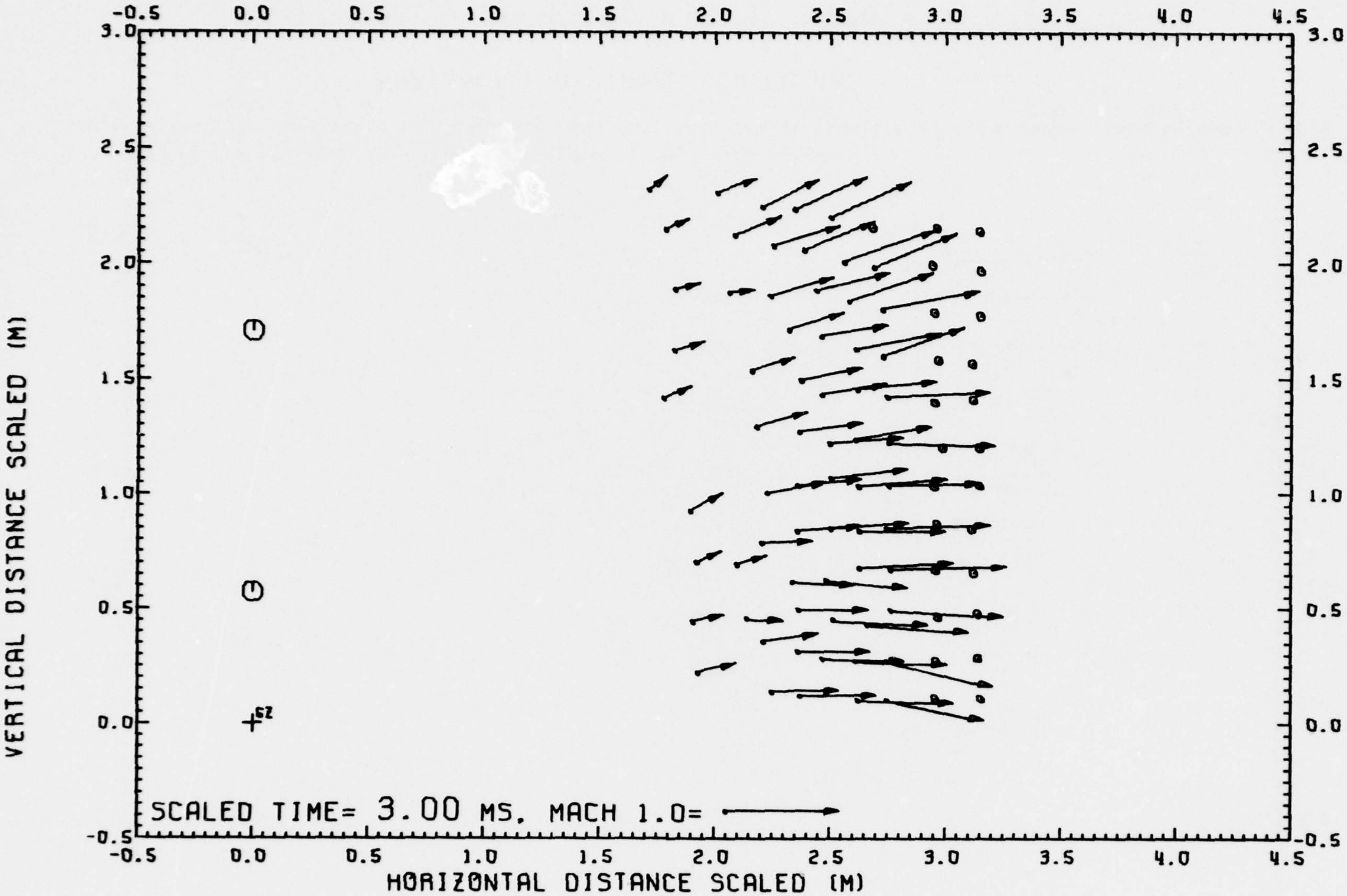


Fig. 12.4 PARTICLE VELOCITY FIELD, DIPOLE WEST/9

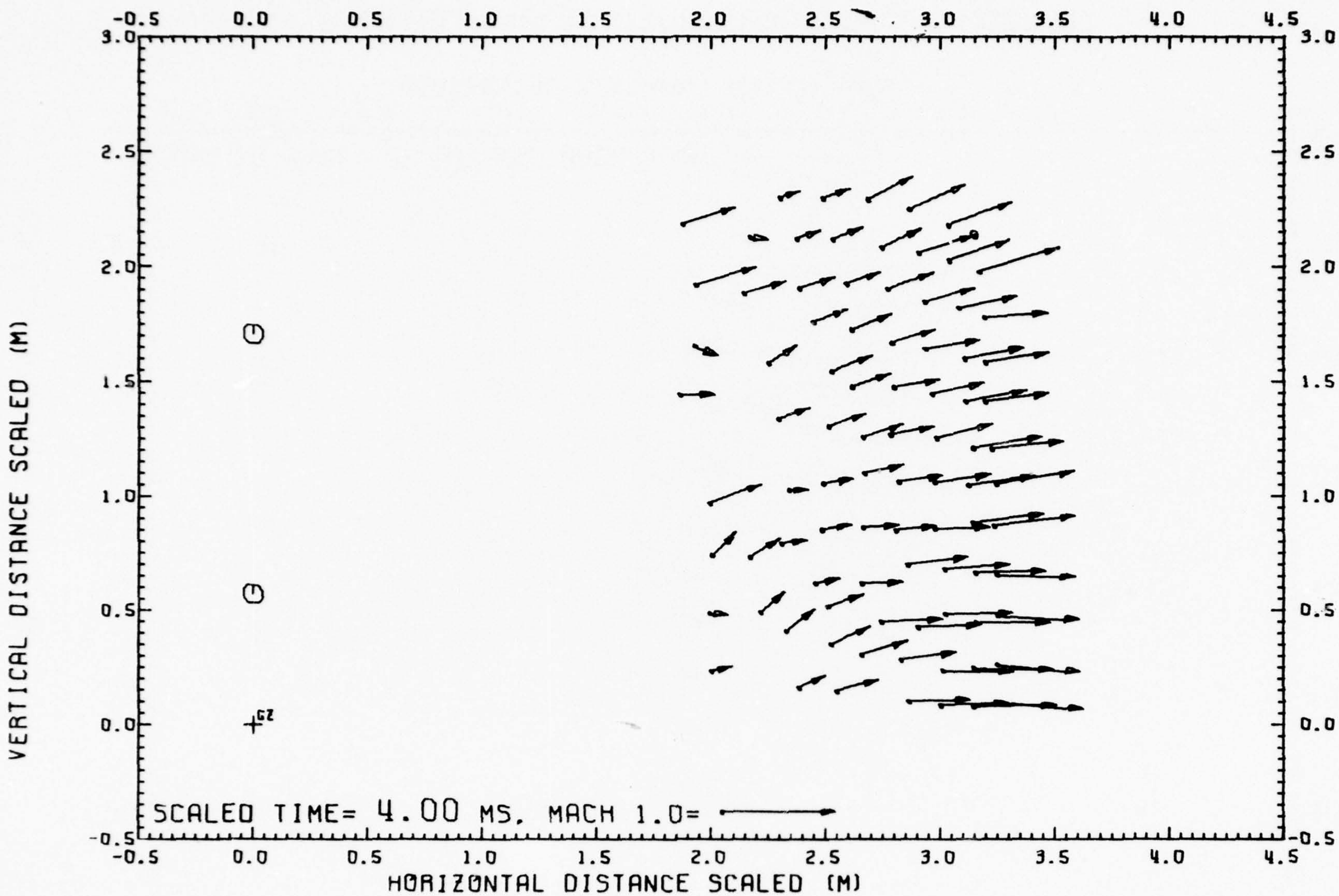


Fig. 12.5 PARTICLE VELOCITY FIELD. DIPOLE WEST/9

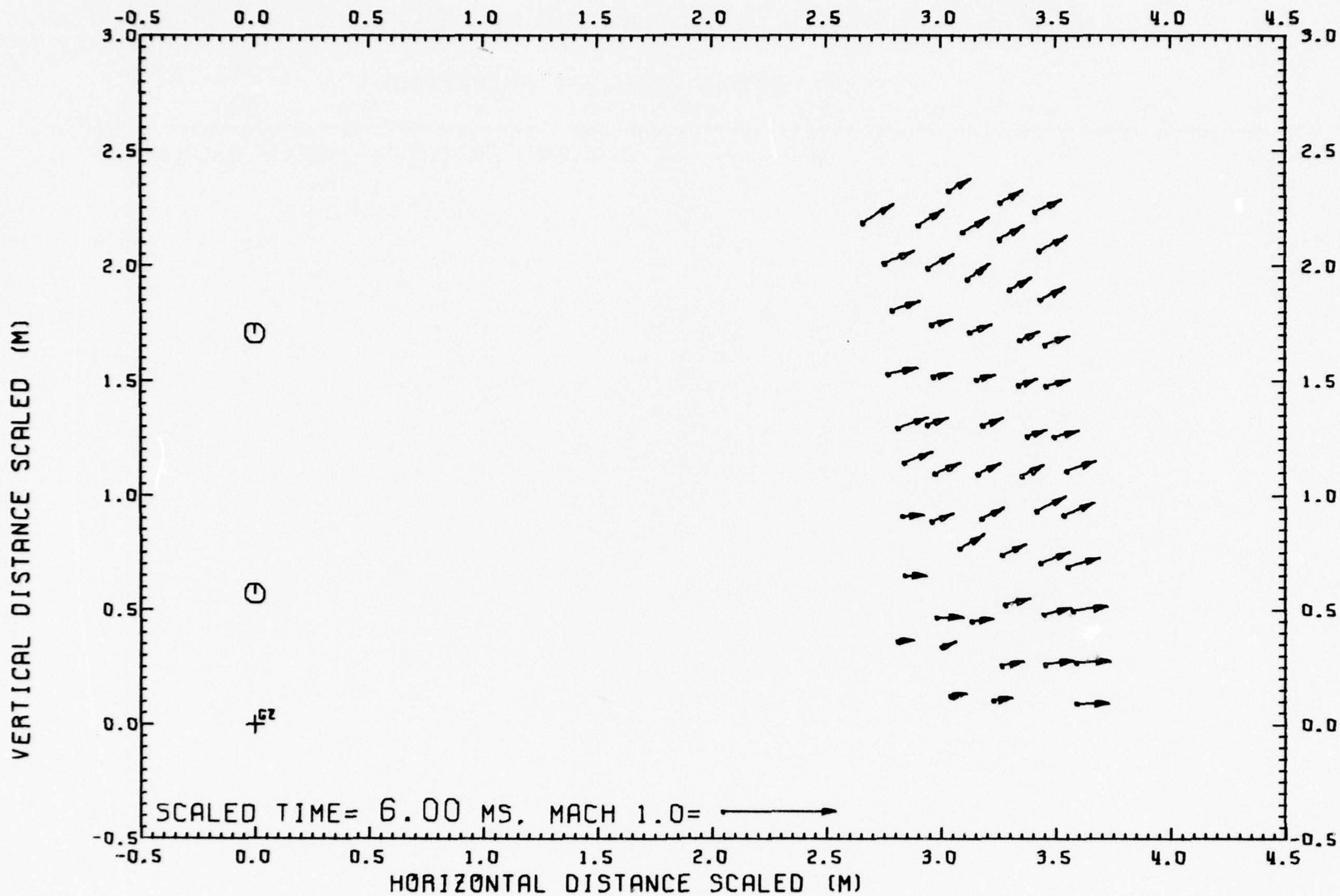


Fig. 12.6 PARTICLE VELOCITY FIELD, DIPOLE WEST/9

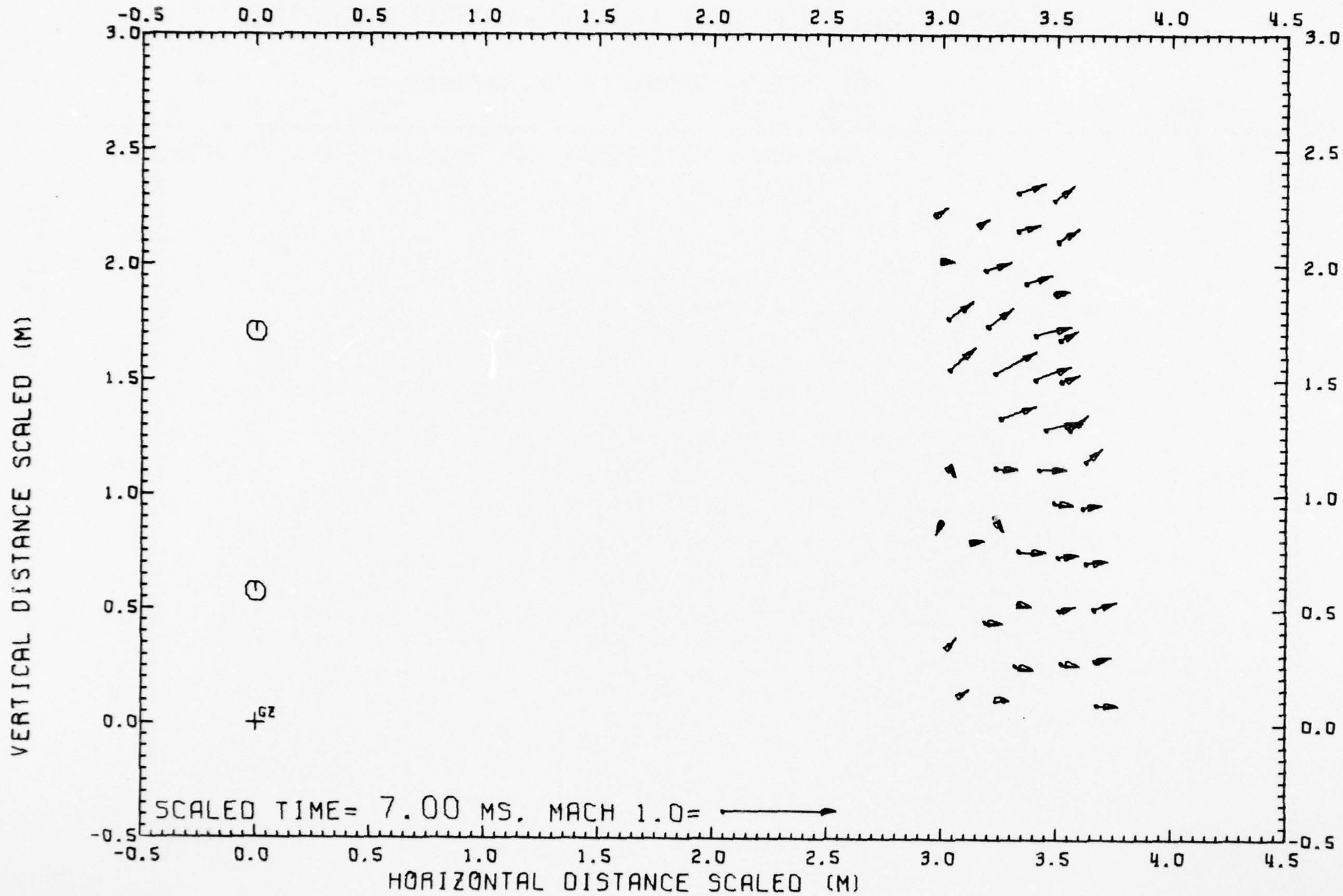


Fig. 12.7 PARTICLE VELOCITY FIELD. DIPOLE WEST/9

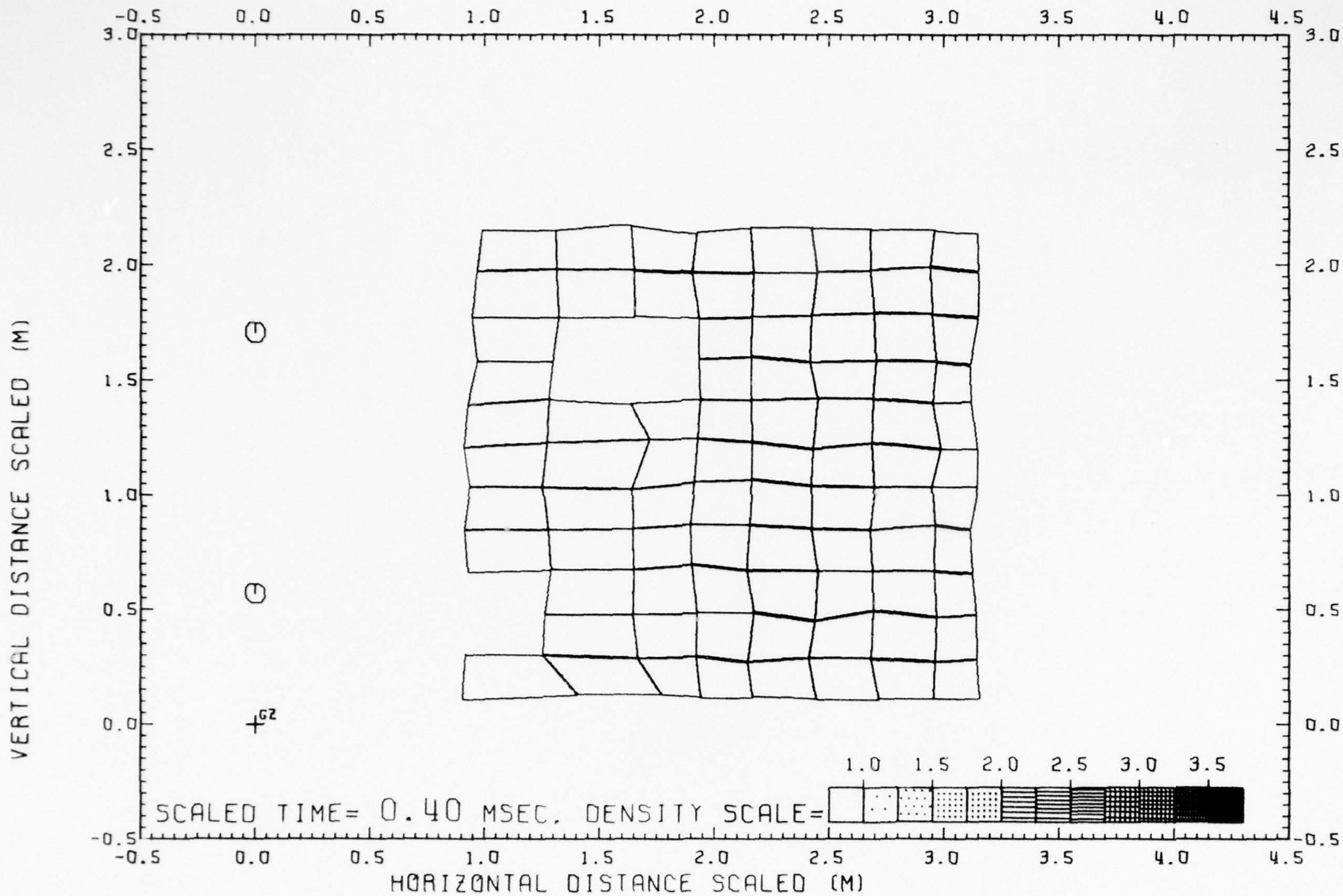


Fig. 13.1 DENSITY FIELD, DIPOLE WEST/9

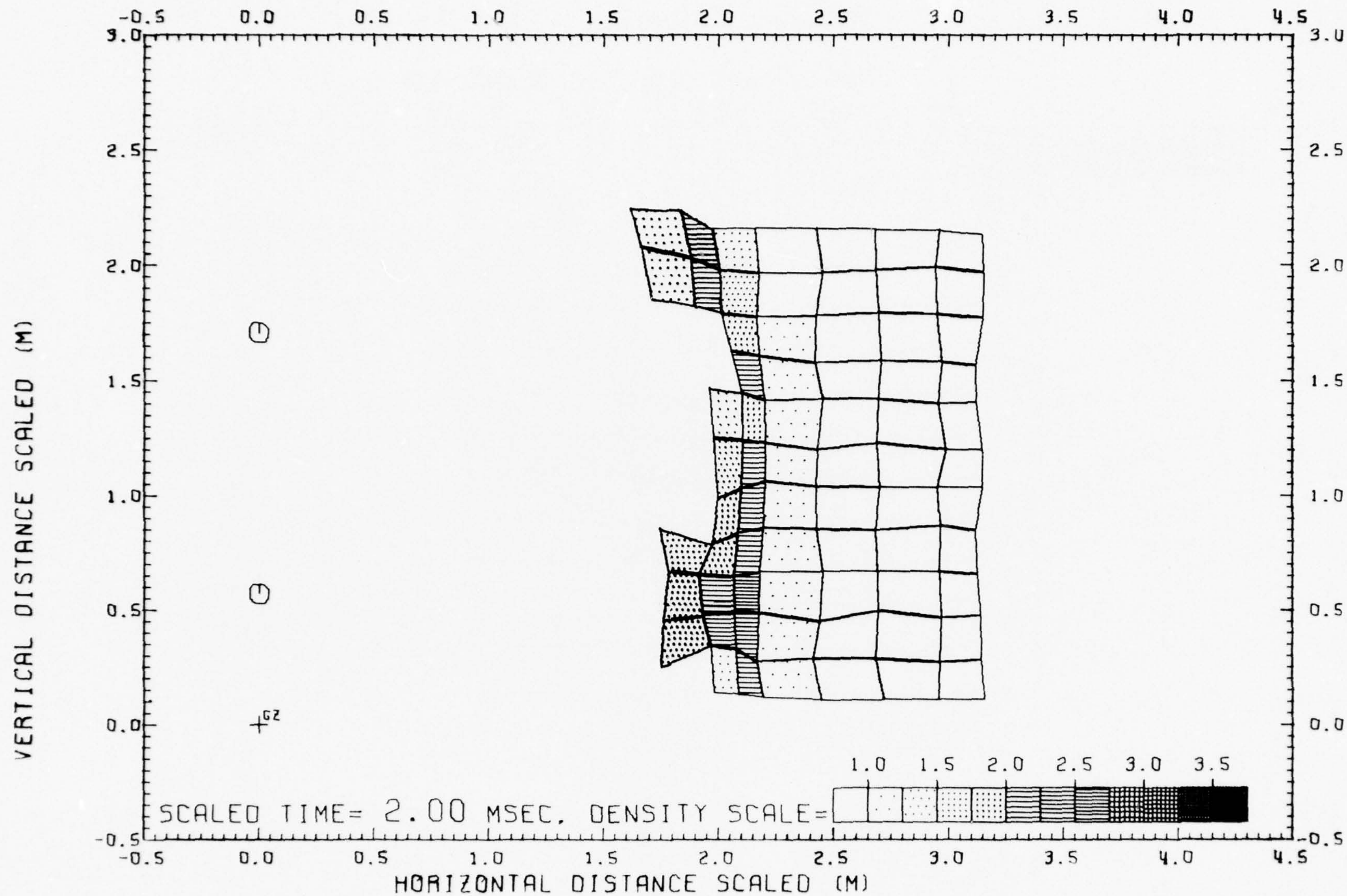


Fig. 13.2 DENSITY FIELD, DIPOLE WEST/9

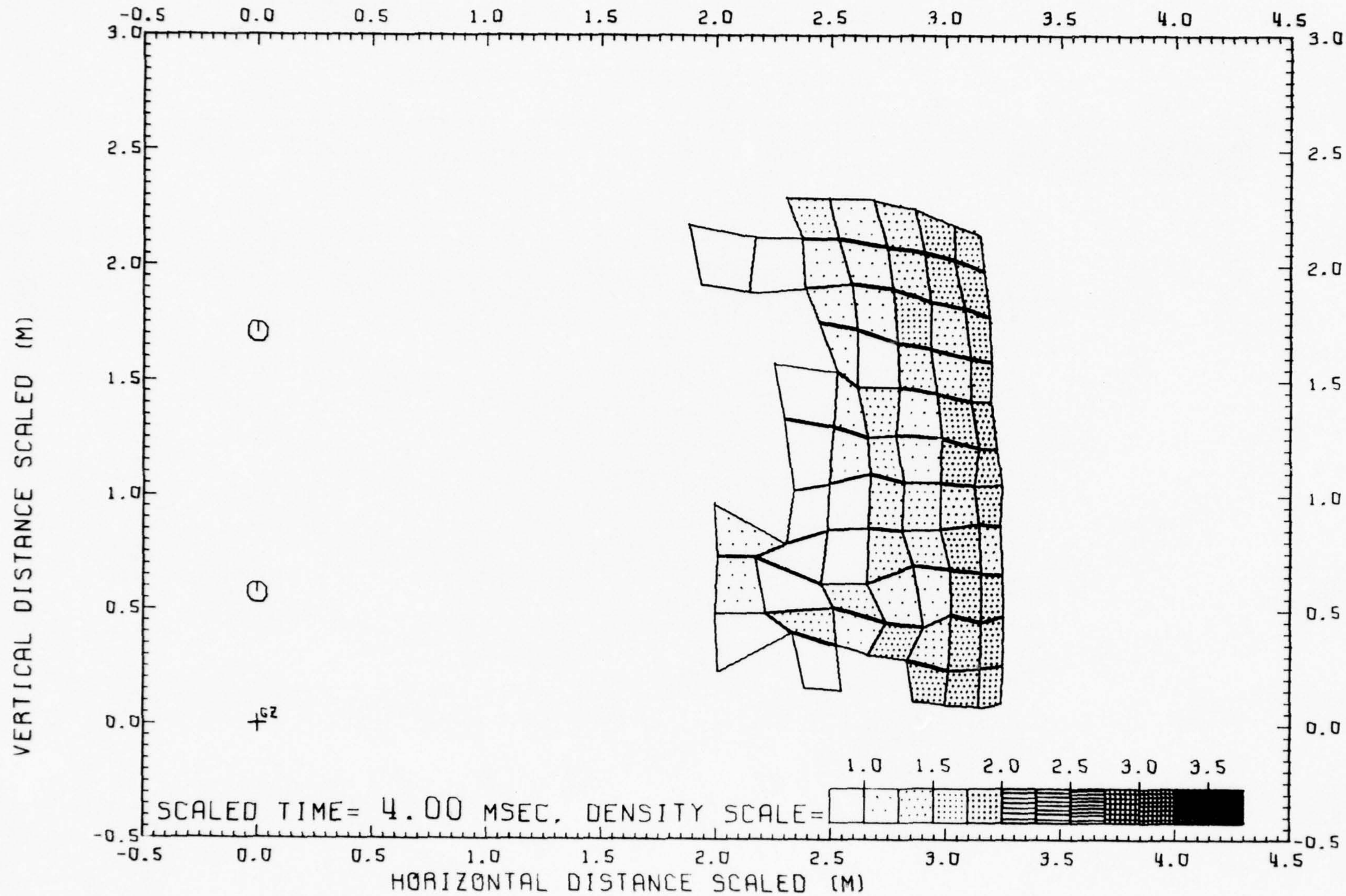


Fig. 13.3 DENSITY FIELD, DIPOLE WEST/9

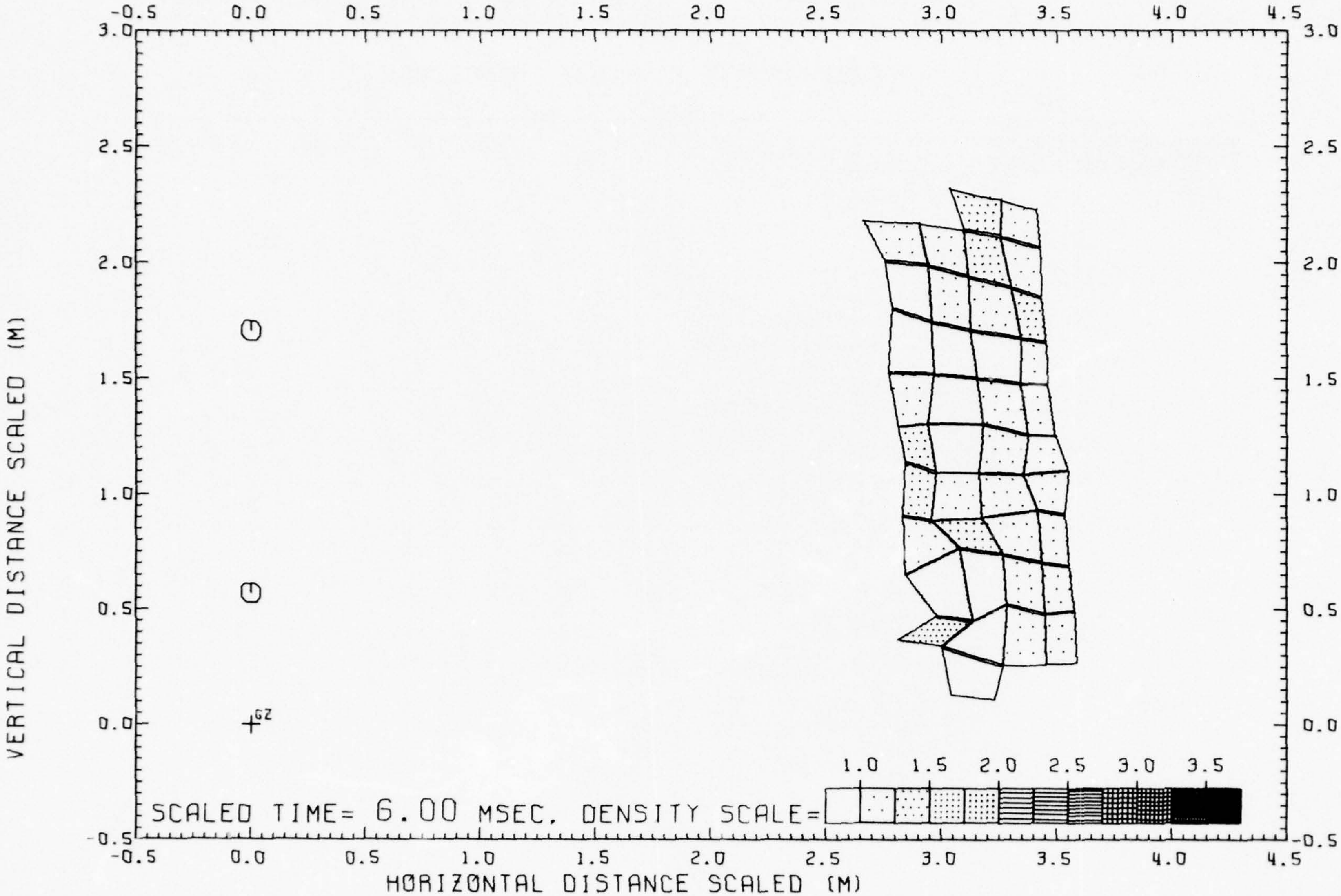


Fig. 13.4 DENSITY FIELD, DIPØLE WEST/9

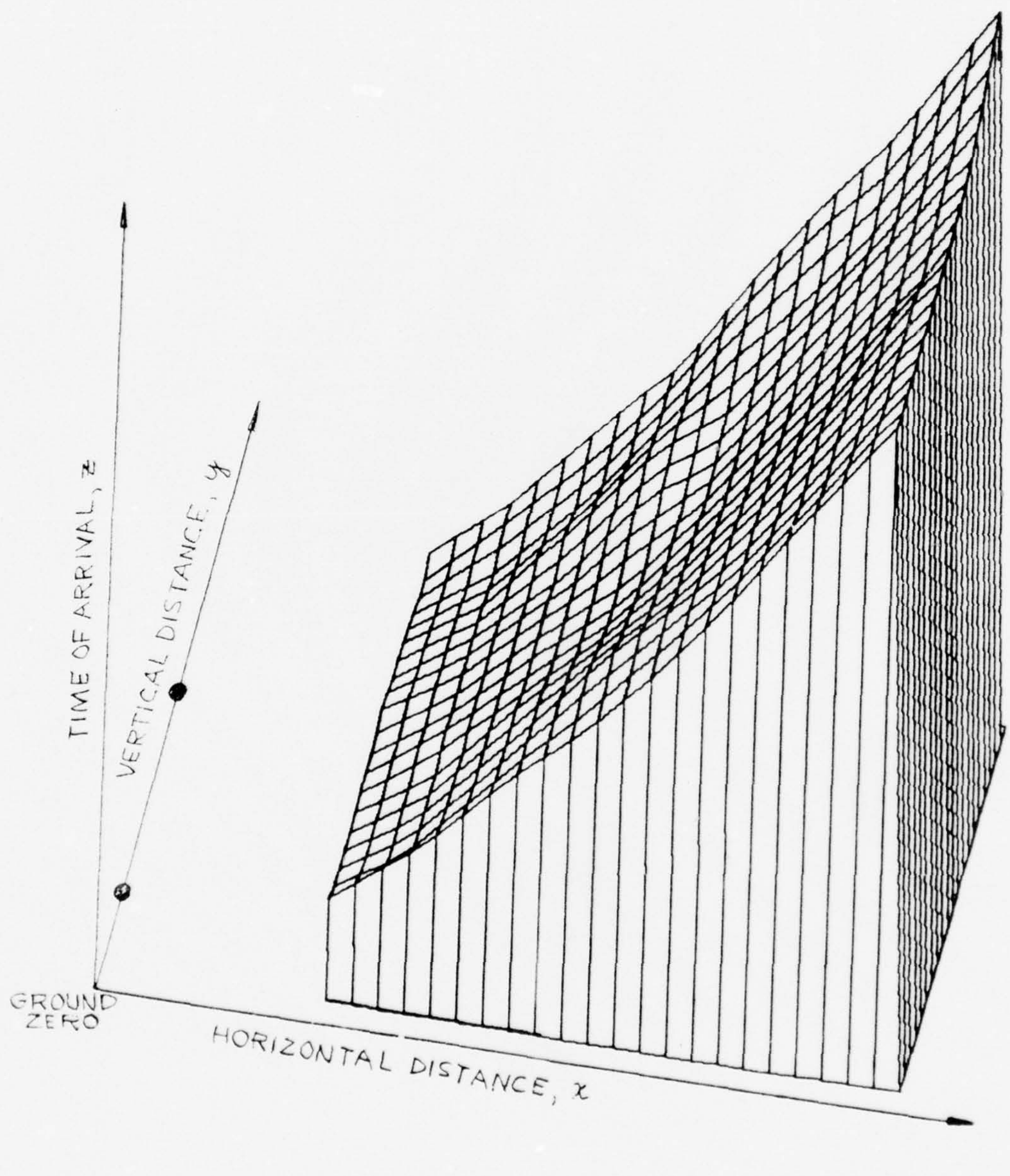


Fig. 14 Time-of-arrival surface, Dipole West/9

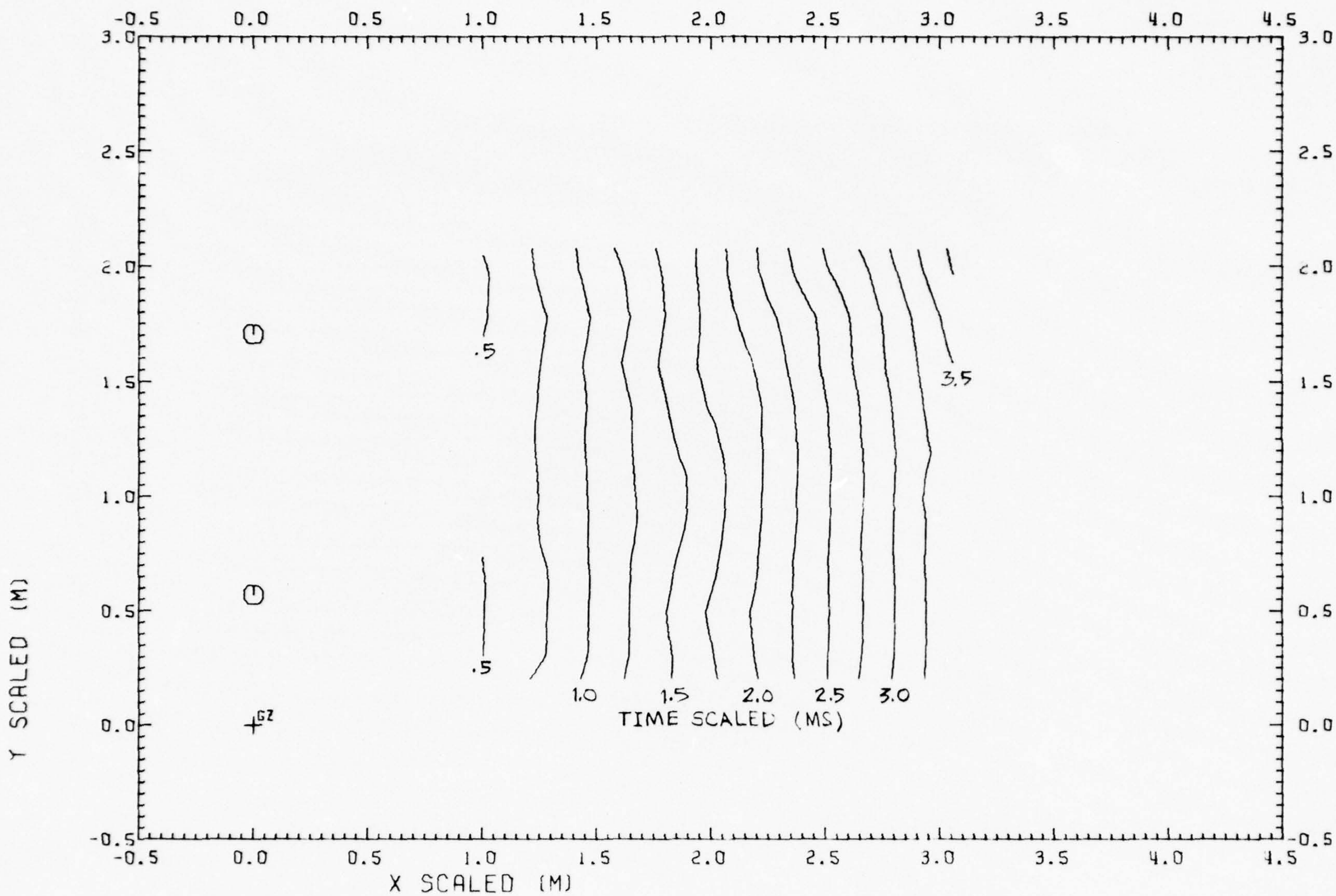


Fig. 15 SHOCK FRONT SHAPES, DIPOLE WEST/9

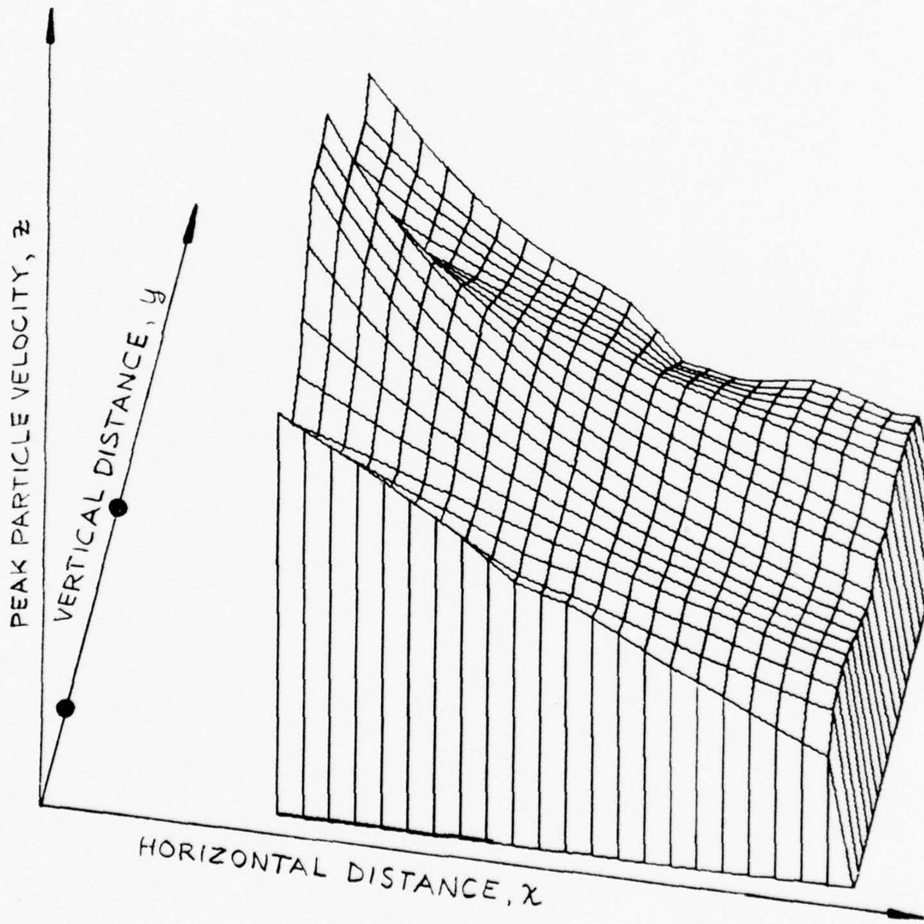


Fig. 16 A shock strength surface, Dipole West/9

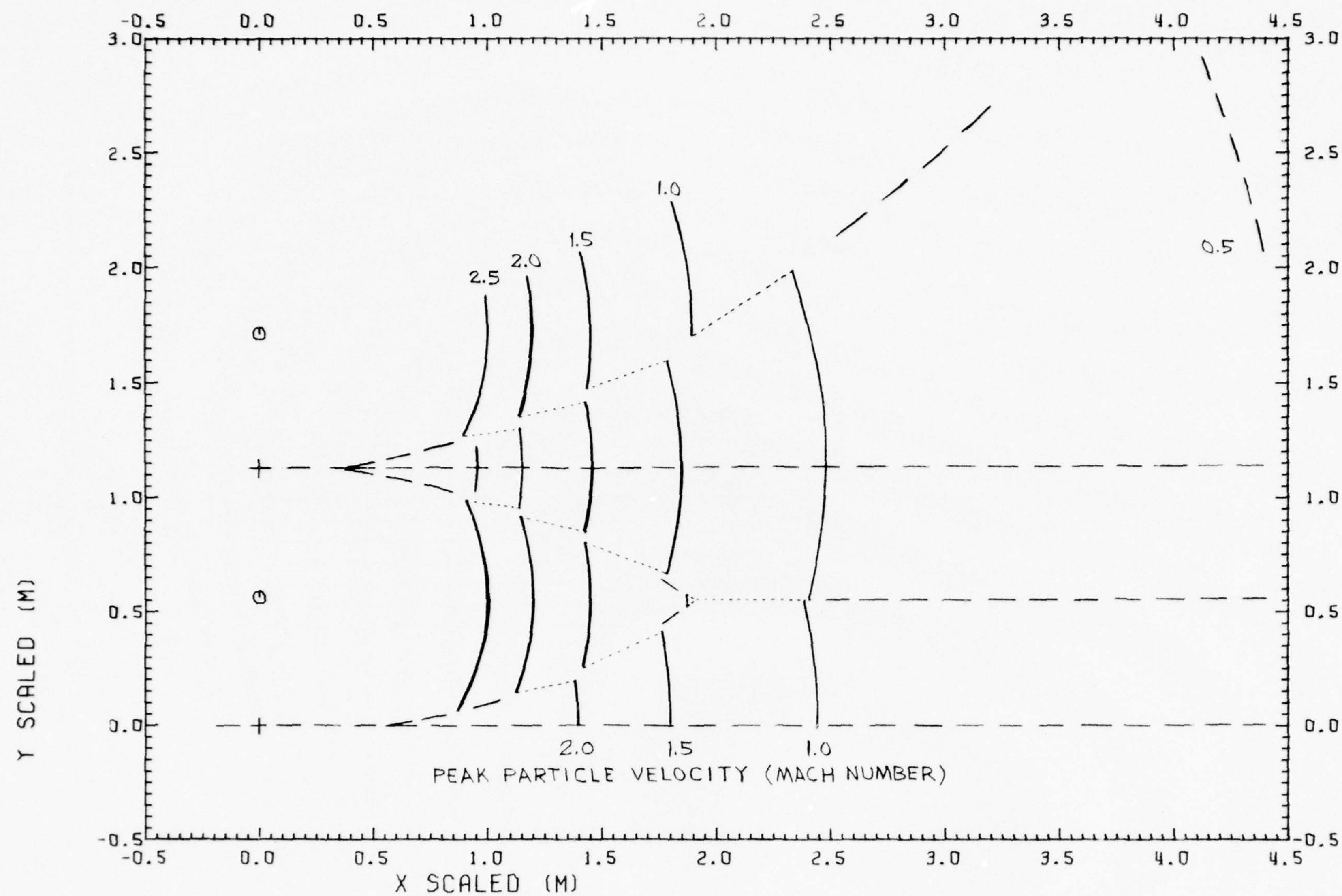


Fig. 17 SHOCK STRENGTH CONTOURS, DIPOLE WEST/9

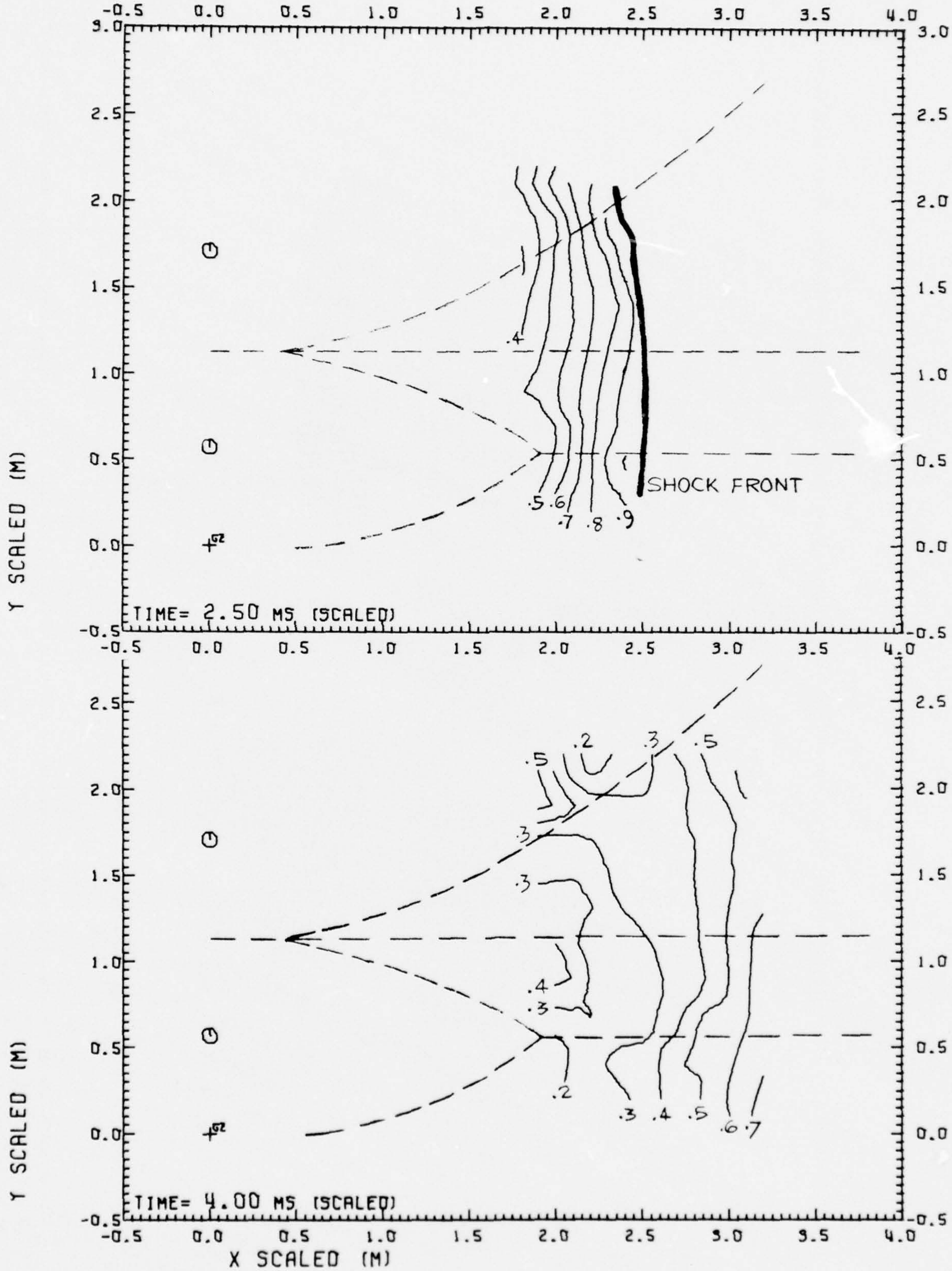


Fig. 18 DIPOLE WEST/9 PARTICLE VELOCITY

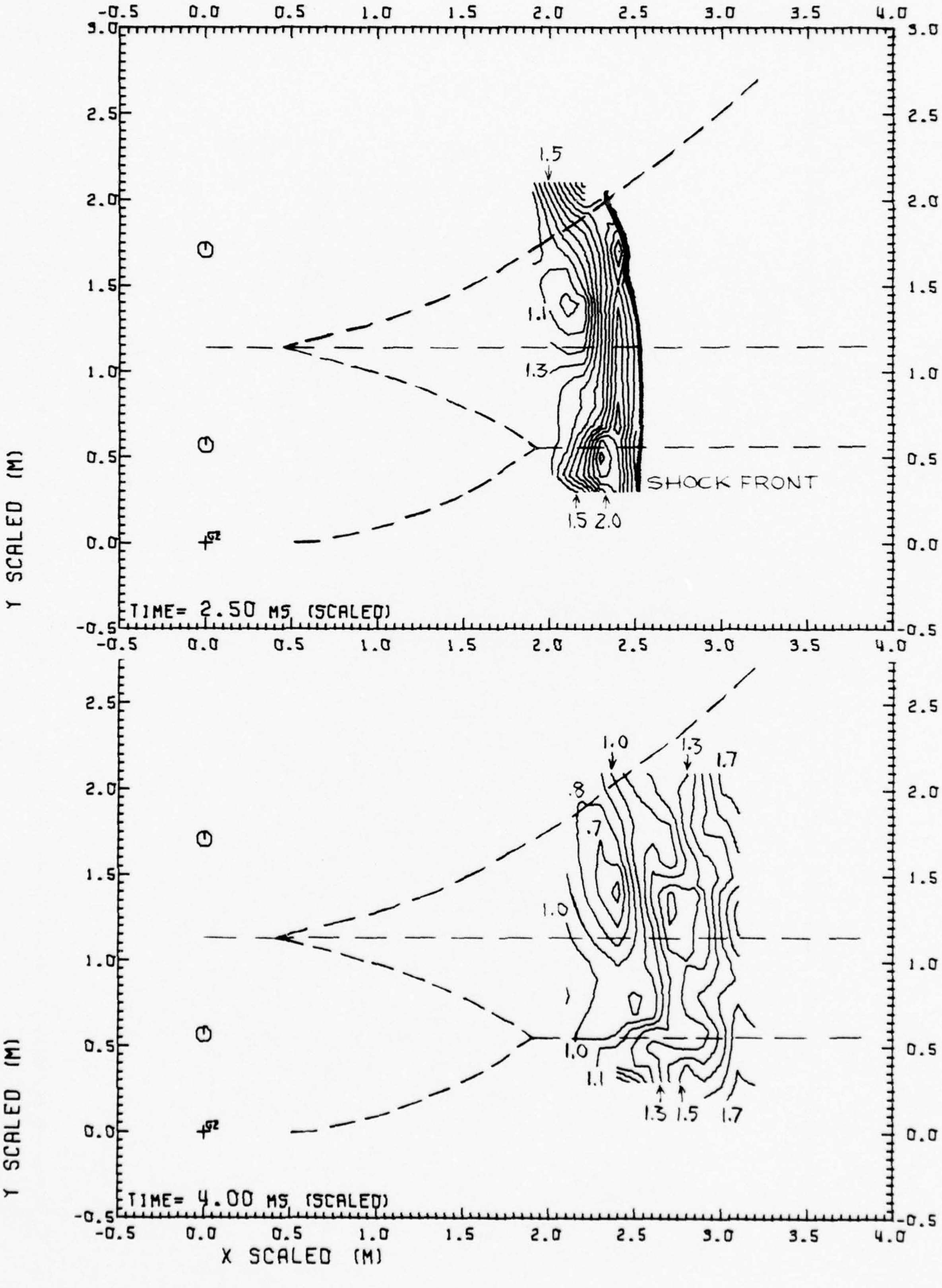


Fig. 19 DIPOLE WEST/9 DENSITY

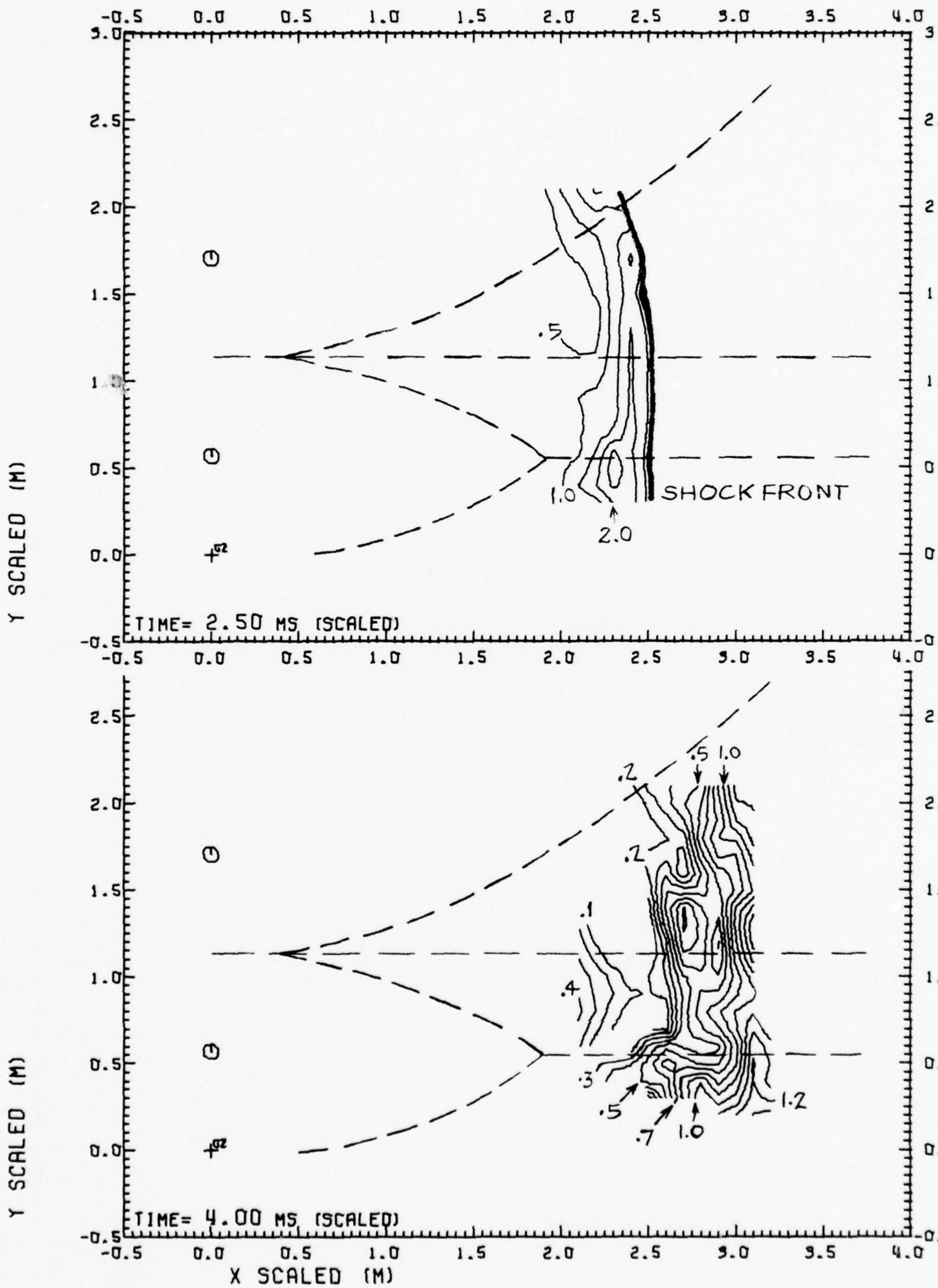


Fig. 20 DIPOLE WEST/9 HYDROSTATIC OVERPRESSURE

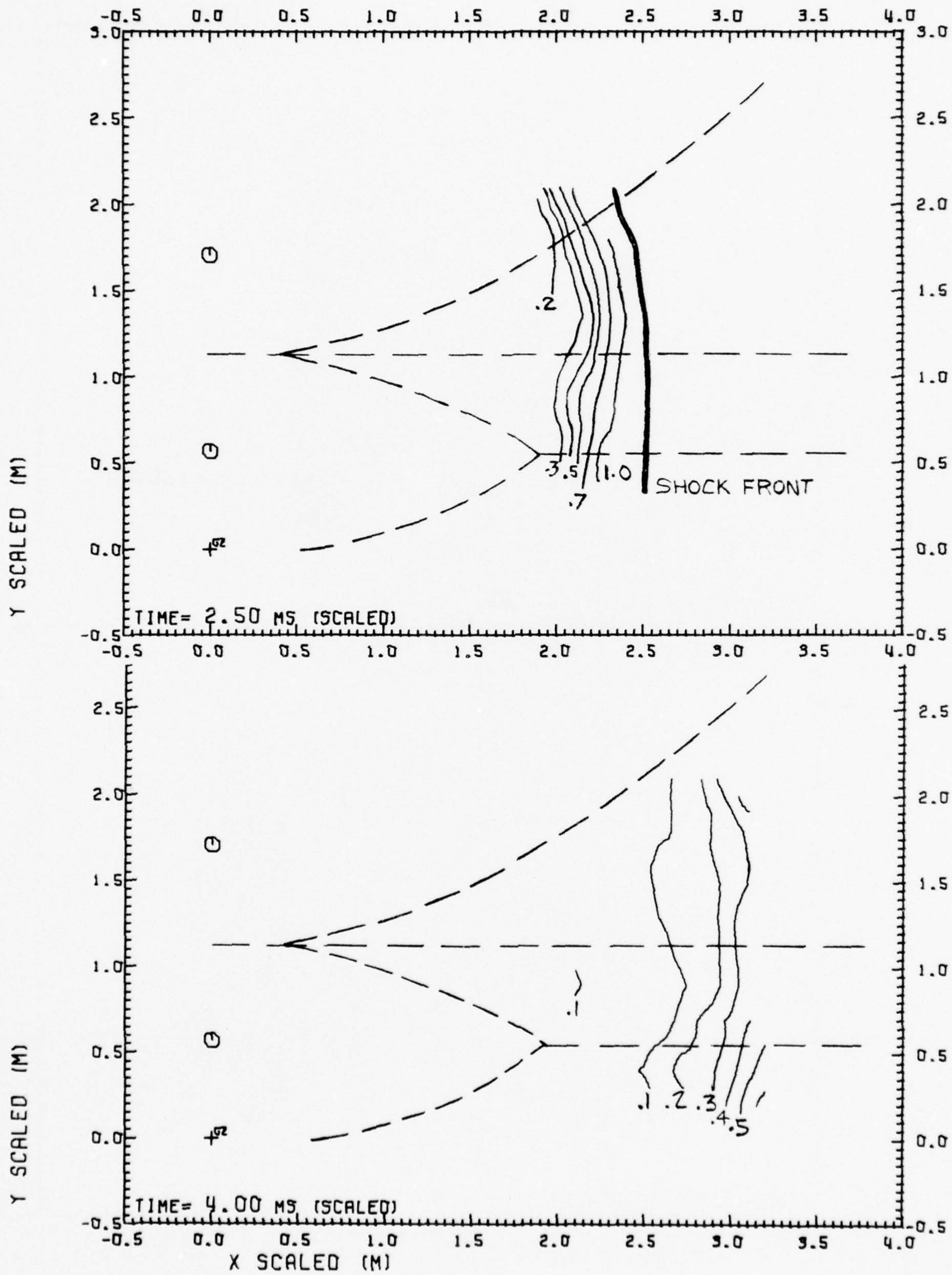


Fig. 21 DIPOLE WEST/9 DYNAMIC PRESSURE

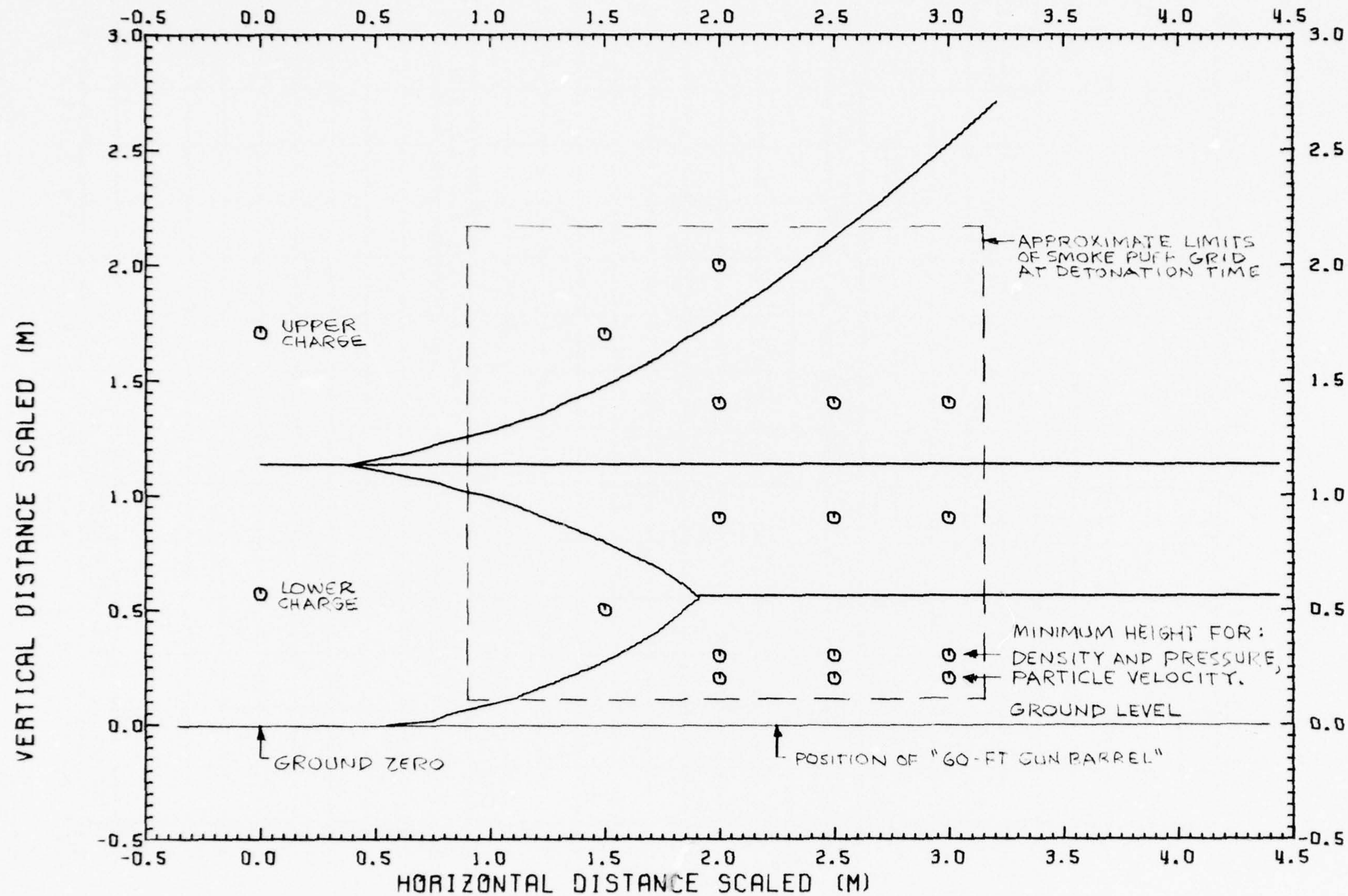


Fig. 22 TIME HISTORY STATIONS, DIPOLE WEST/9

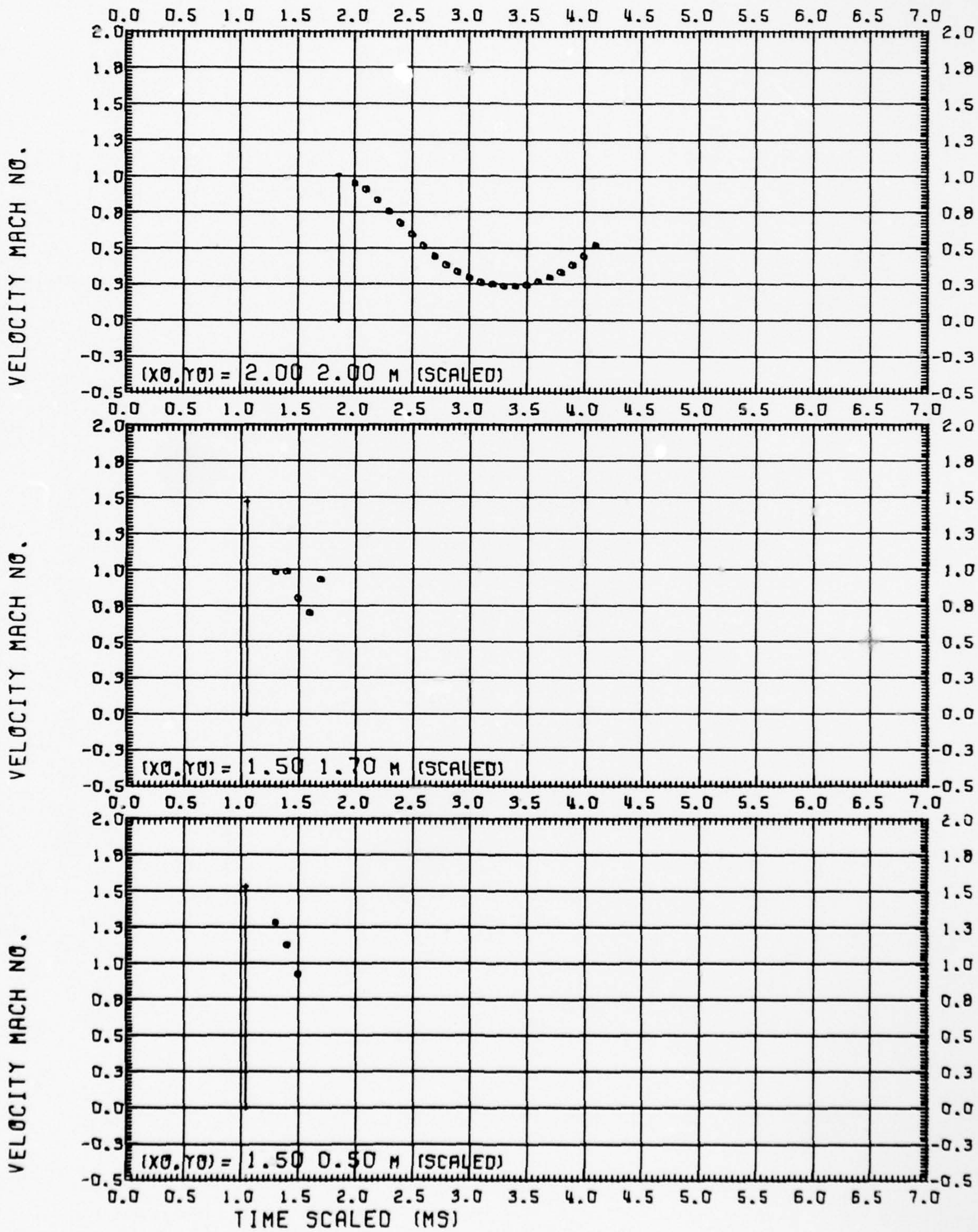


Fig. 23.1 DIPOLE WEST/9 PARTICLE VELOCITY

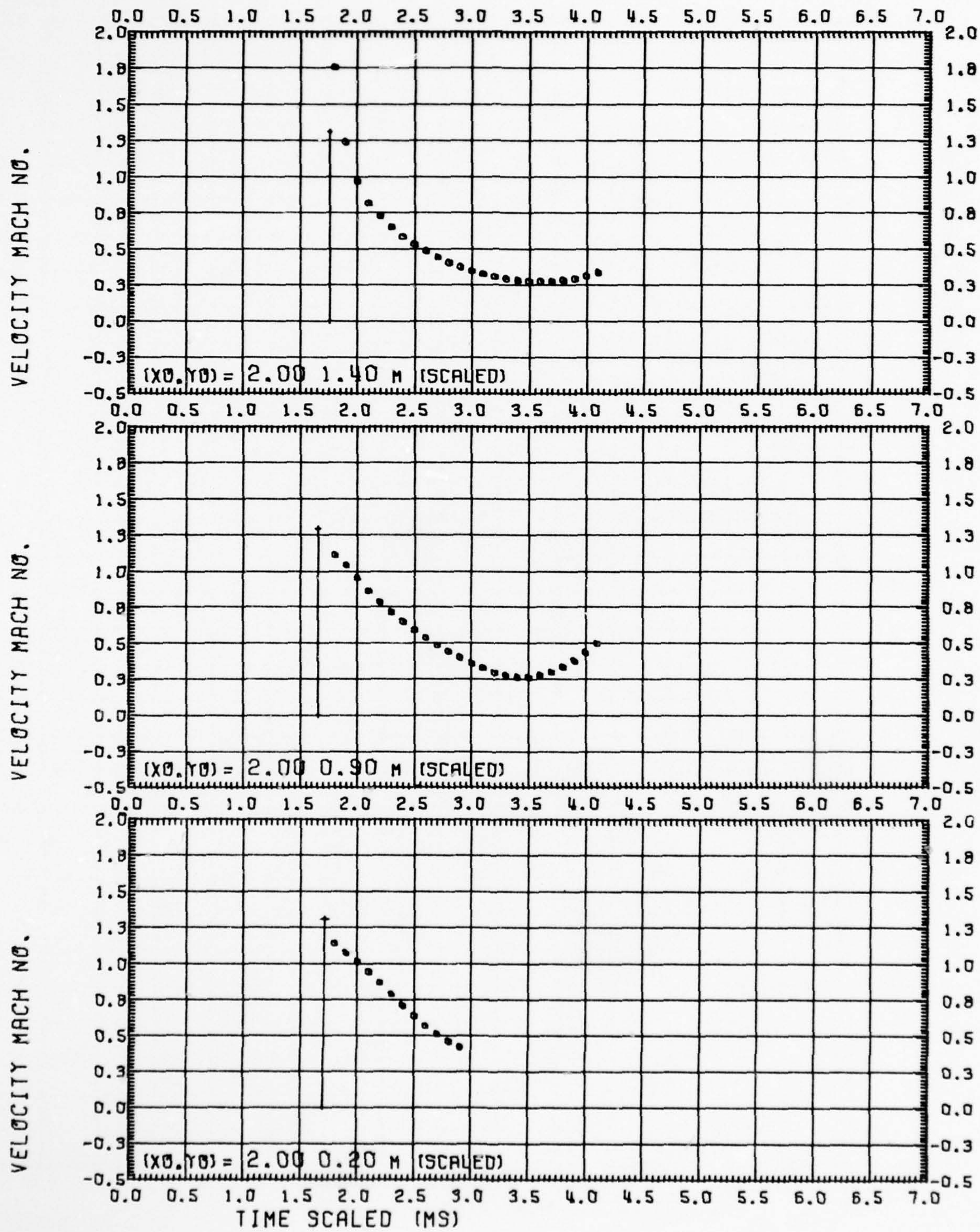


Fig. 23.2 DIPOLE WEST/9 PARTICLE VELOCITY

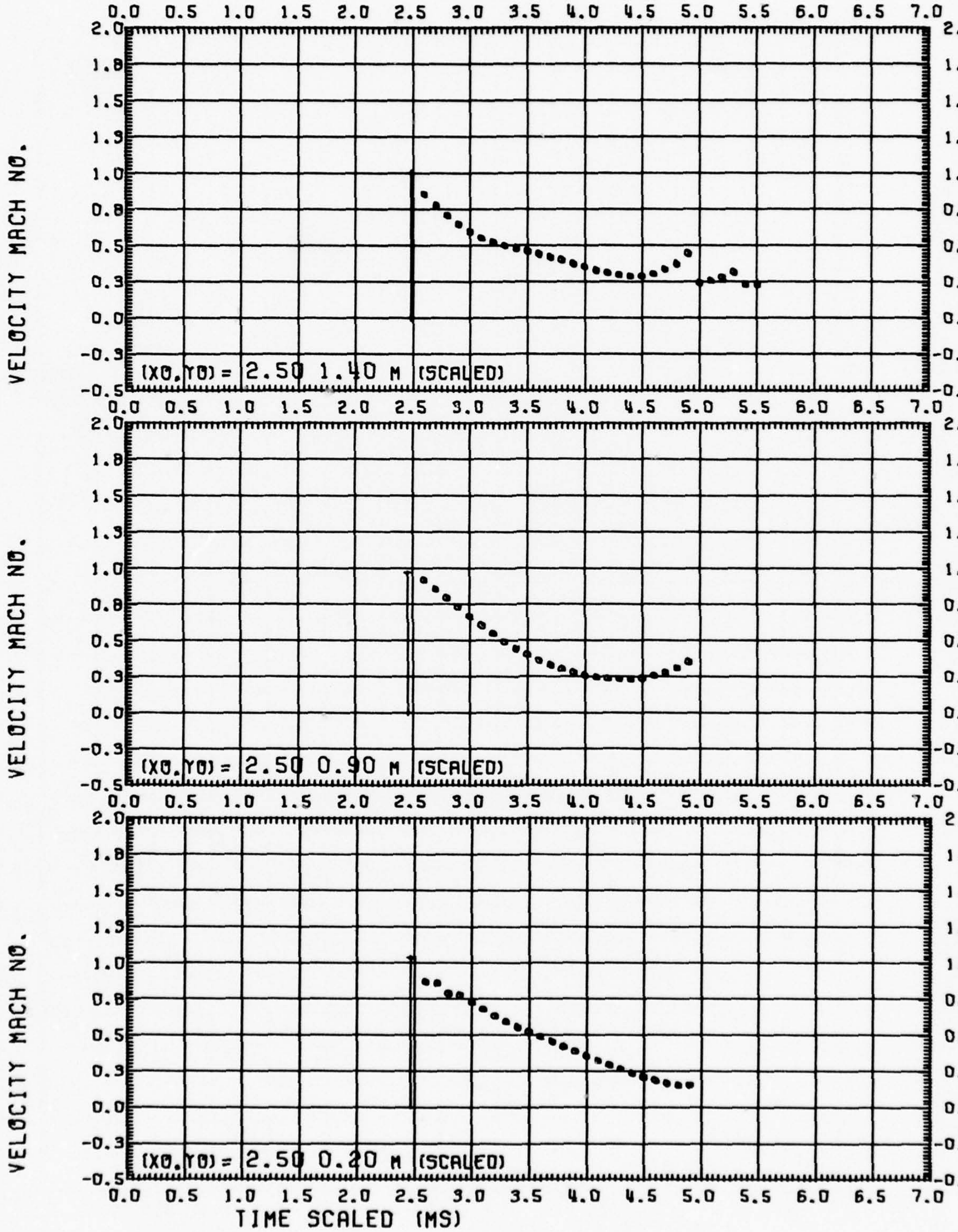


Fig. 23.3 DIPOLE WEST/9 PARTICLE VELOCITY

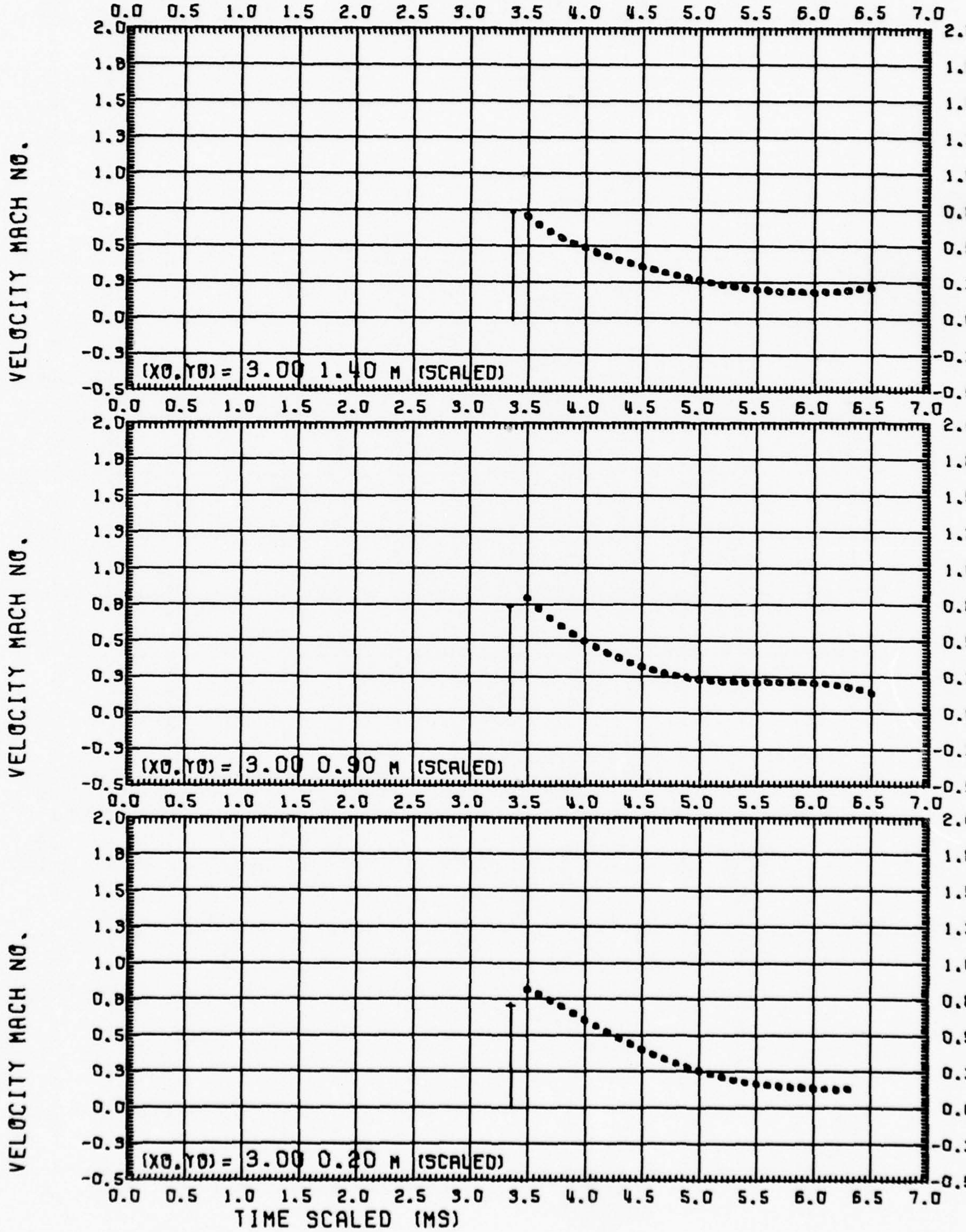


Fig. 23.4 DIPOLE WEST/9 PARTICLE VELOCITY

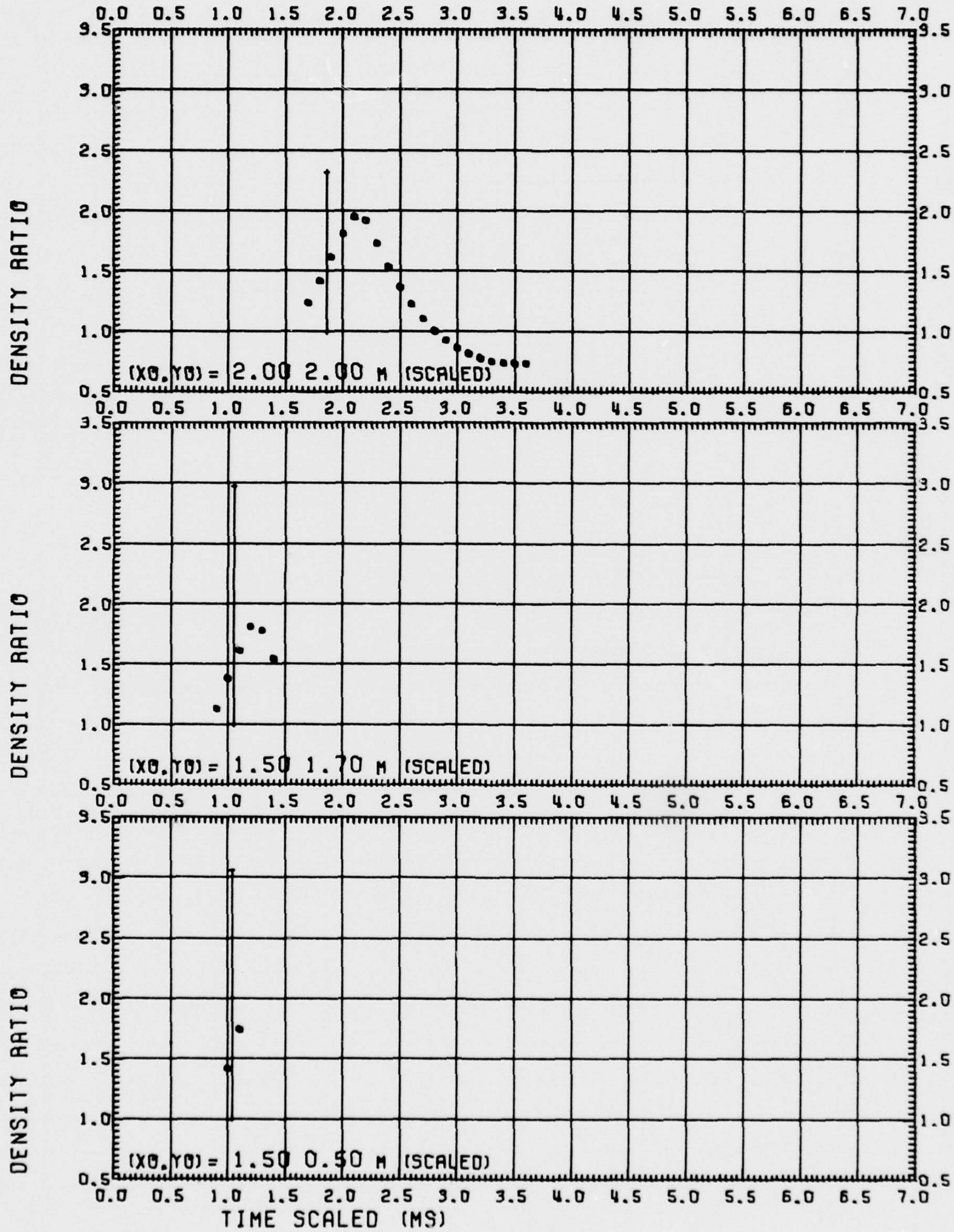


Fig. 24.1 DIPOLE WEST/9 DENSITY

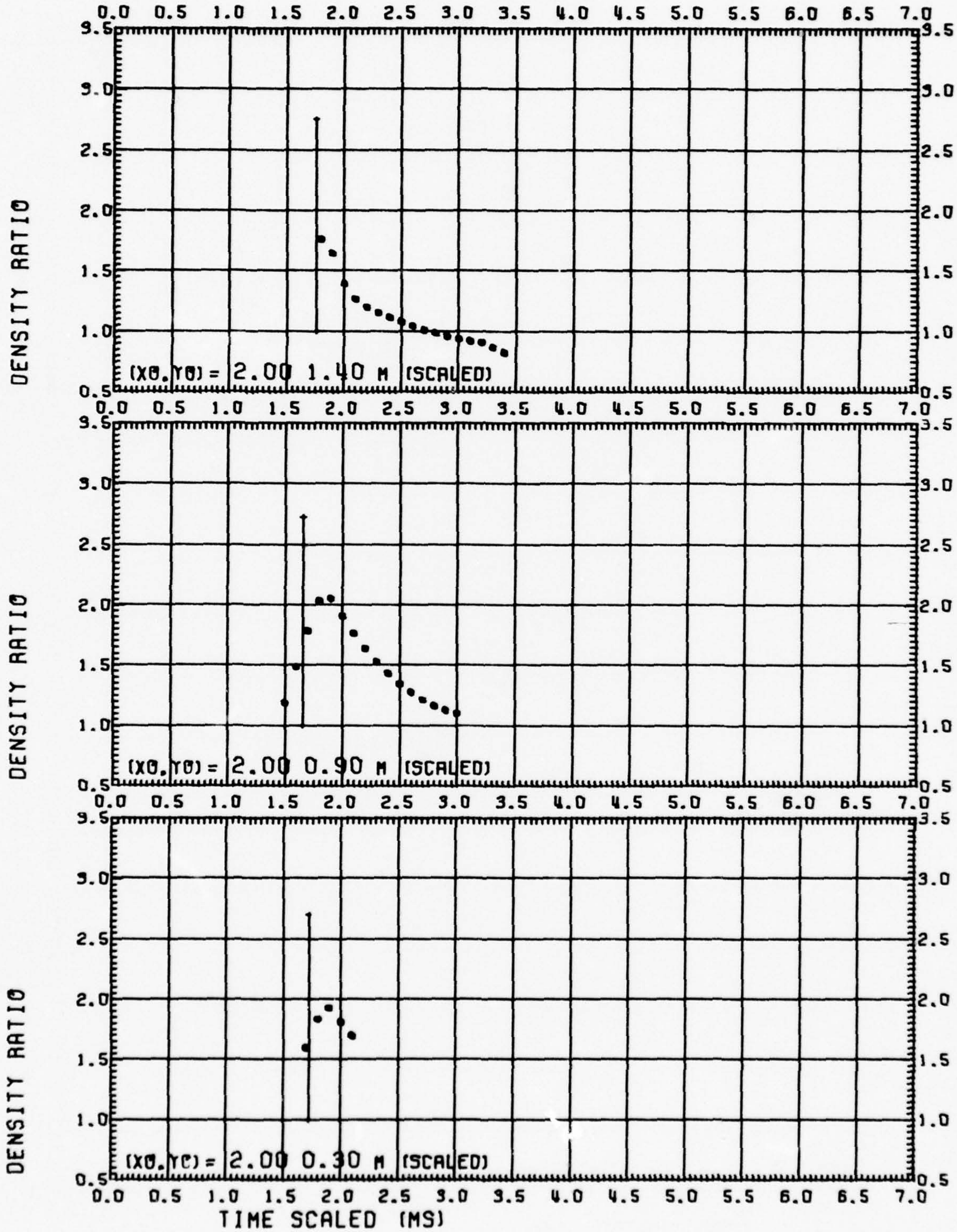


Fig. 24.2 DIPOLE WEST/9 DENSITY

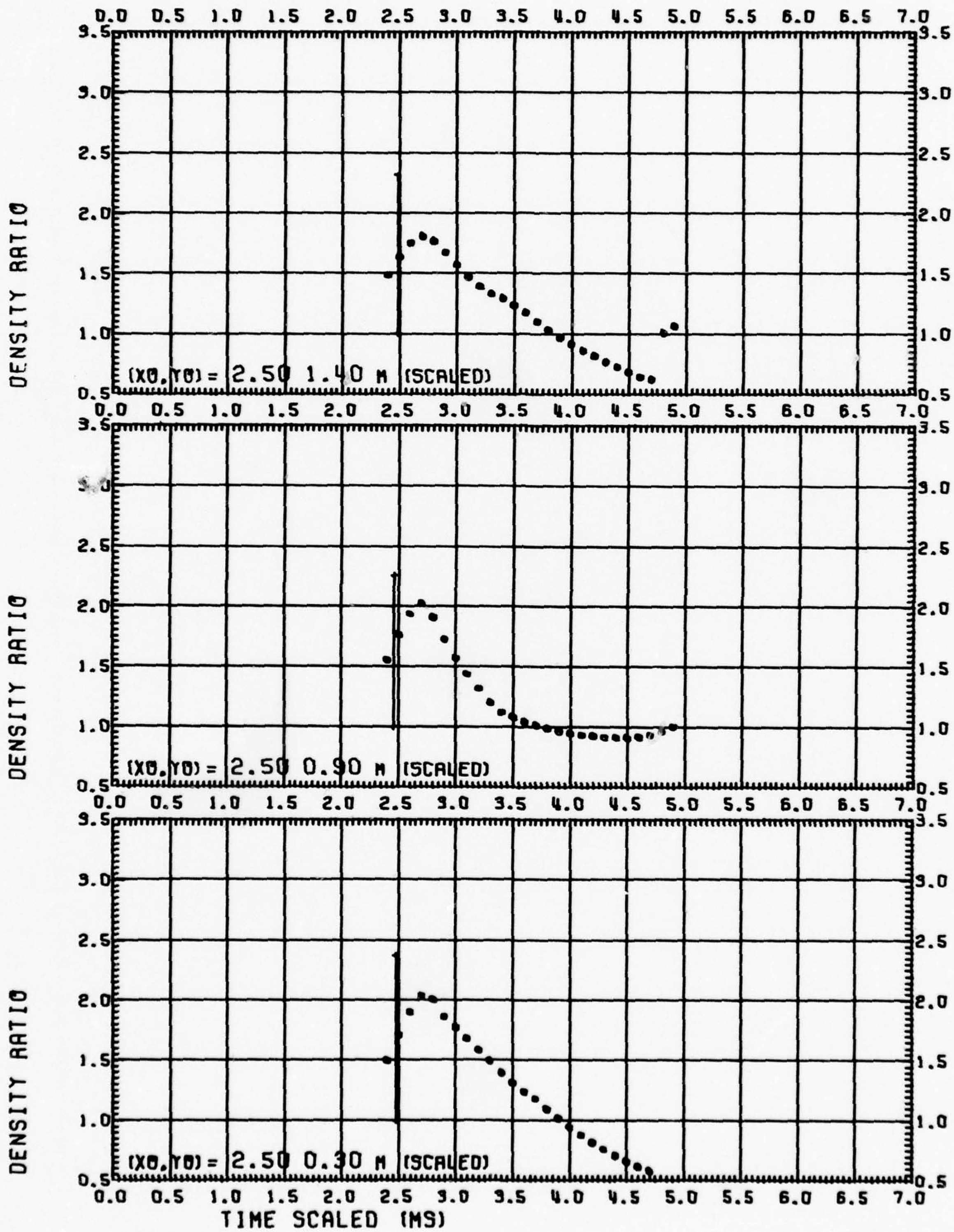


Fig. 24.3 DIPOLE WEST/9 DENSITY

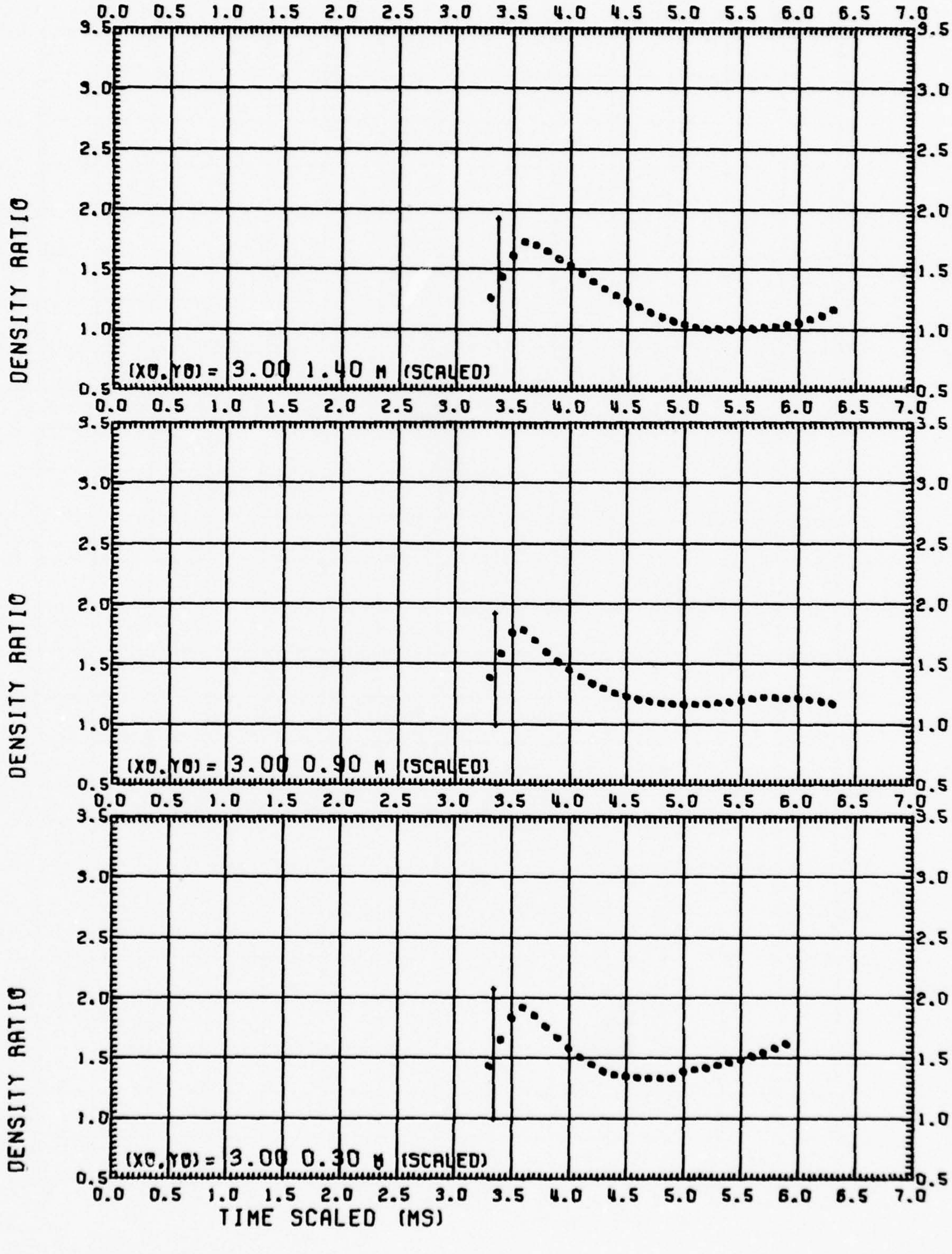


Fig. 24.4 DIPOLE WEST/9 DENSITY

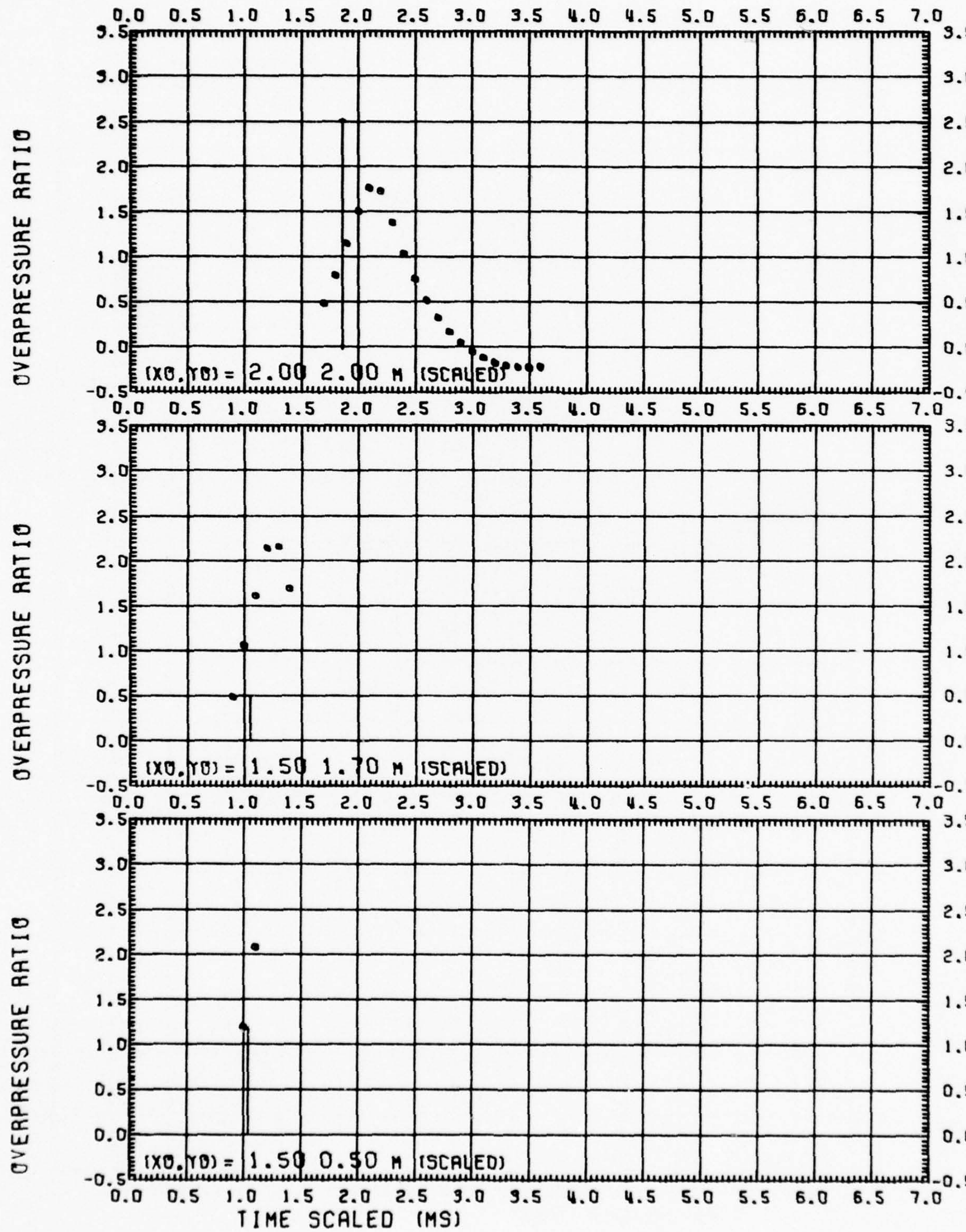


Fig. 25.1 DIPOLE WEST/9 HYDROSTATIC OVERPRESSURE

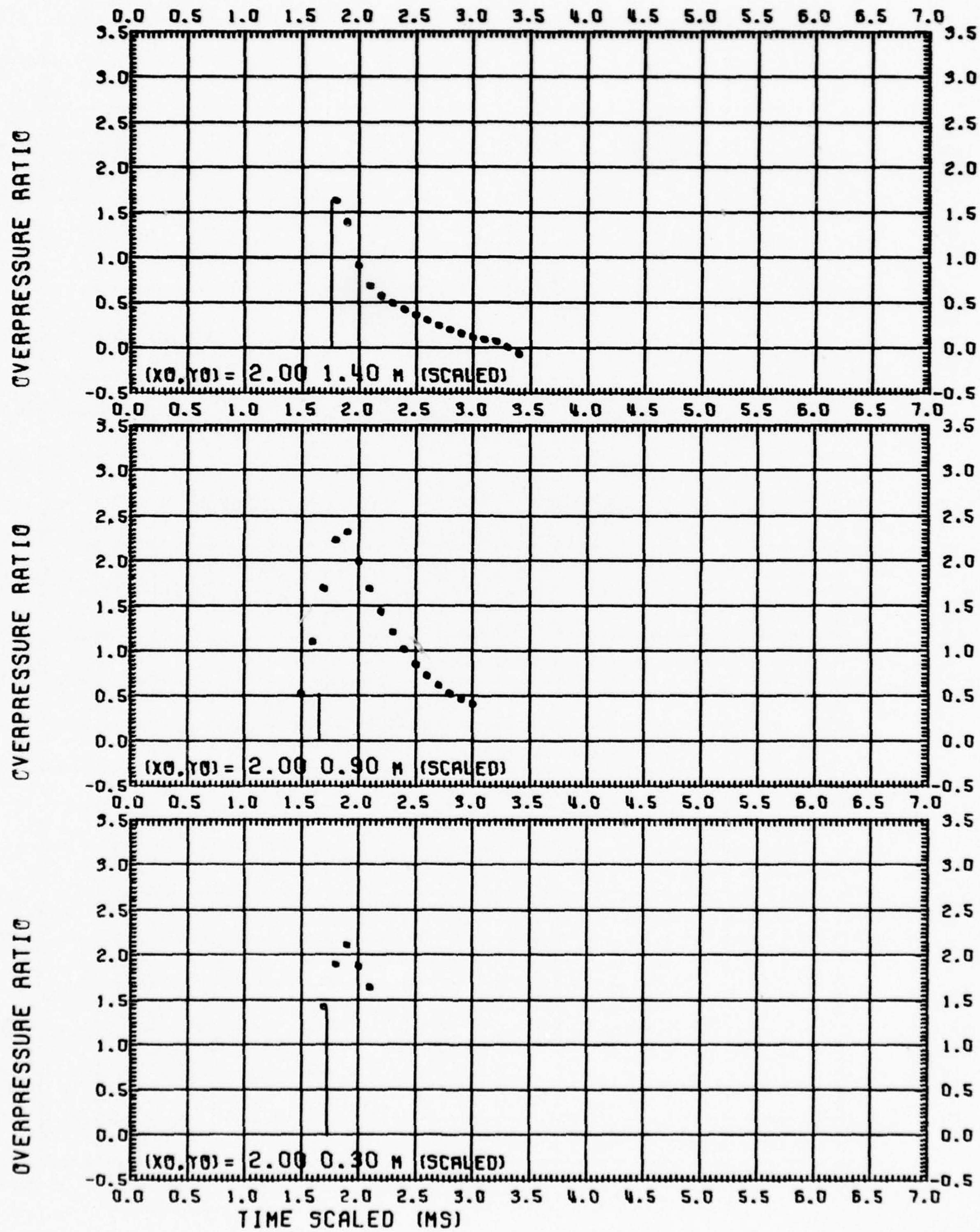


Fig. 25.2 DIPOLE WEST/9 HYDROSTATIC OVERPRESSURE

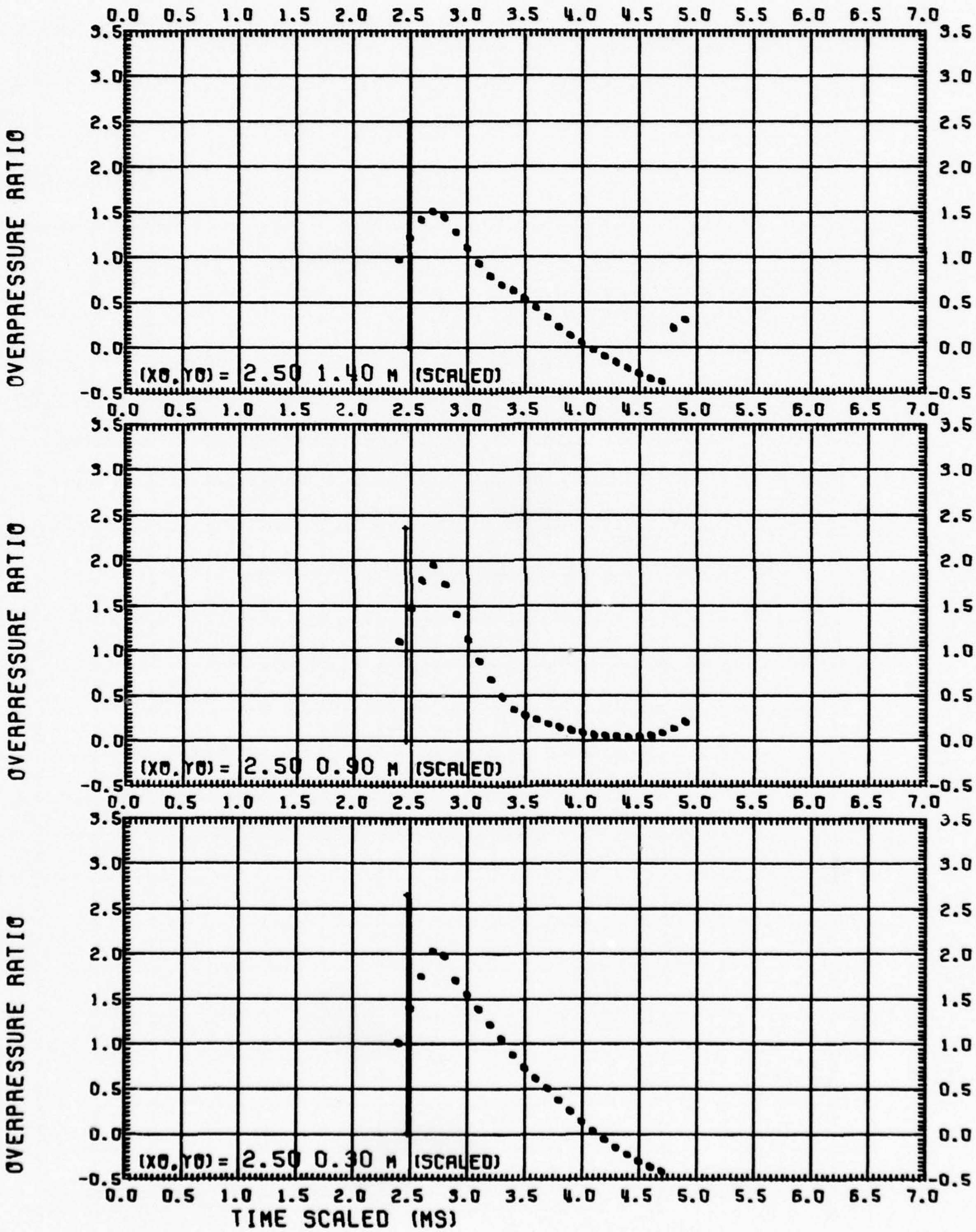


Fig. 25.3 DIPOLE WEST/9 HYDROSTATIC OVERPRESSURE

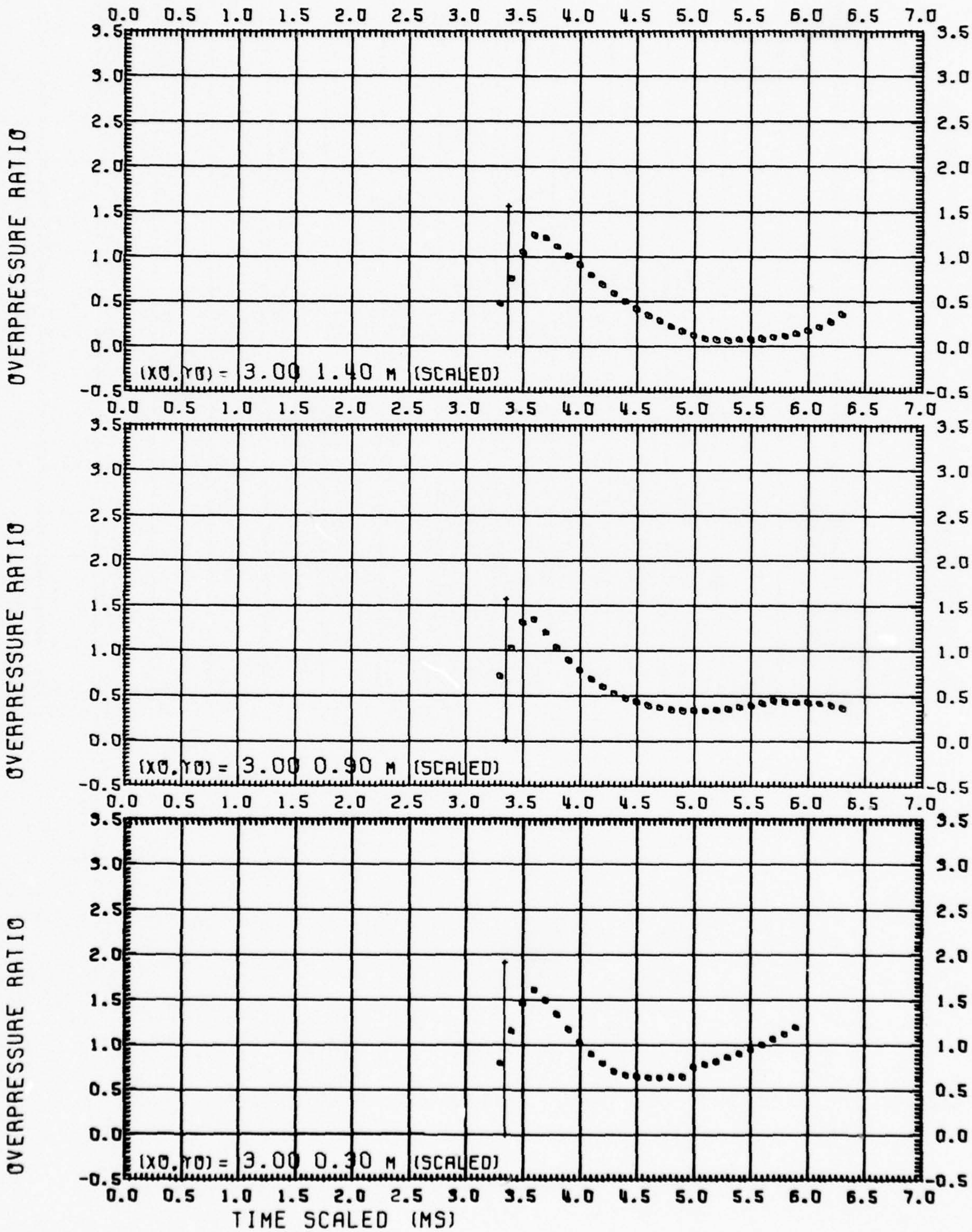
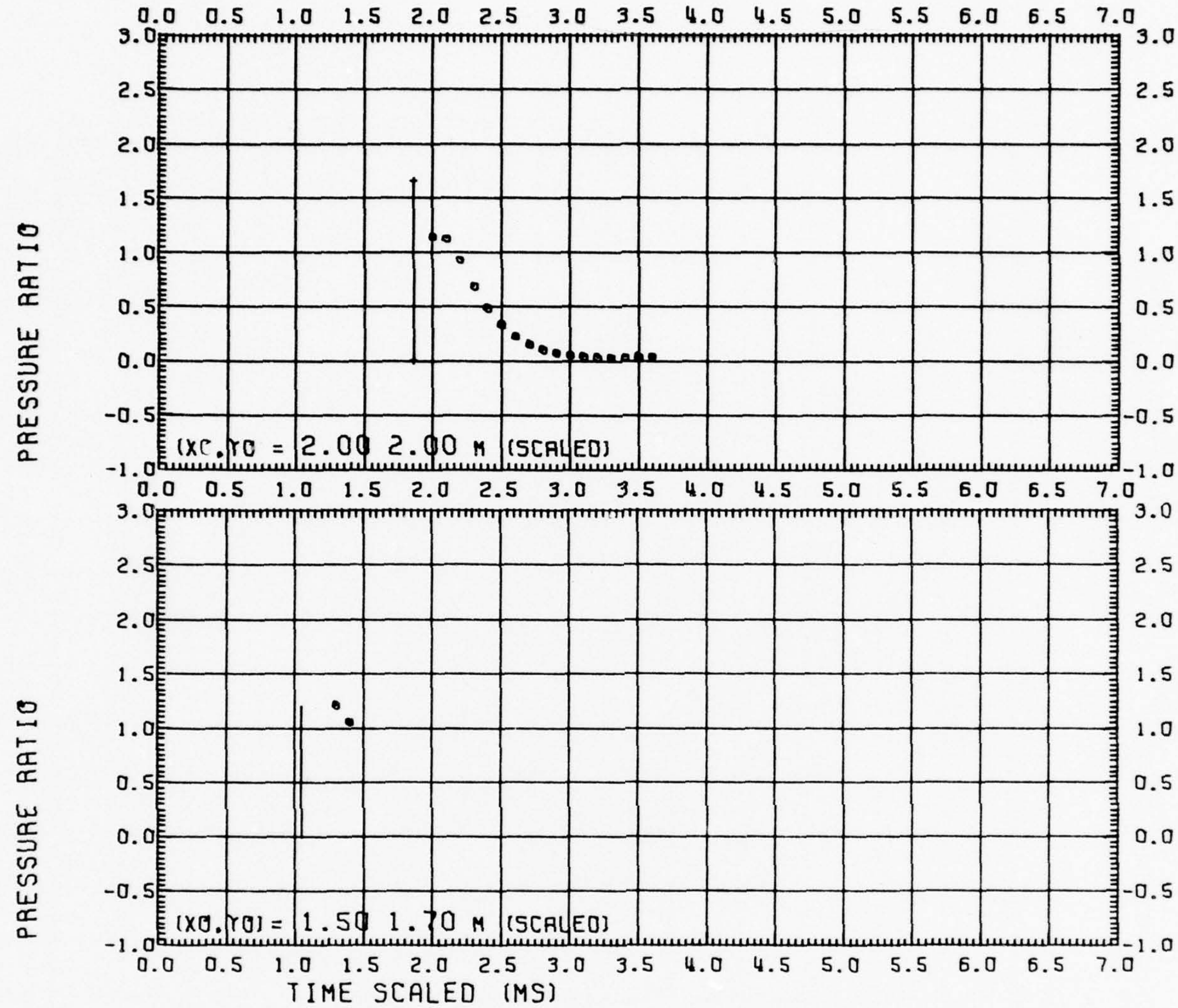


Fig. 25.4 DIPOLE WEST/9 HYDROSTATIC OVERPRESSURE



(XO,YO)= 1.5,0.5 NO DATA

Fig. 26.1 DIPOLE WEST/9 DYNAMIC PRESSURE

(XO,YO)= 2.5, 1.5 NO DATA

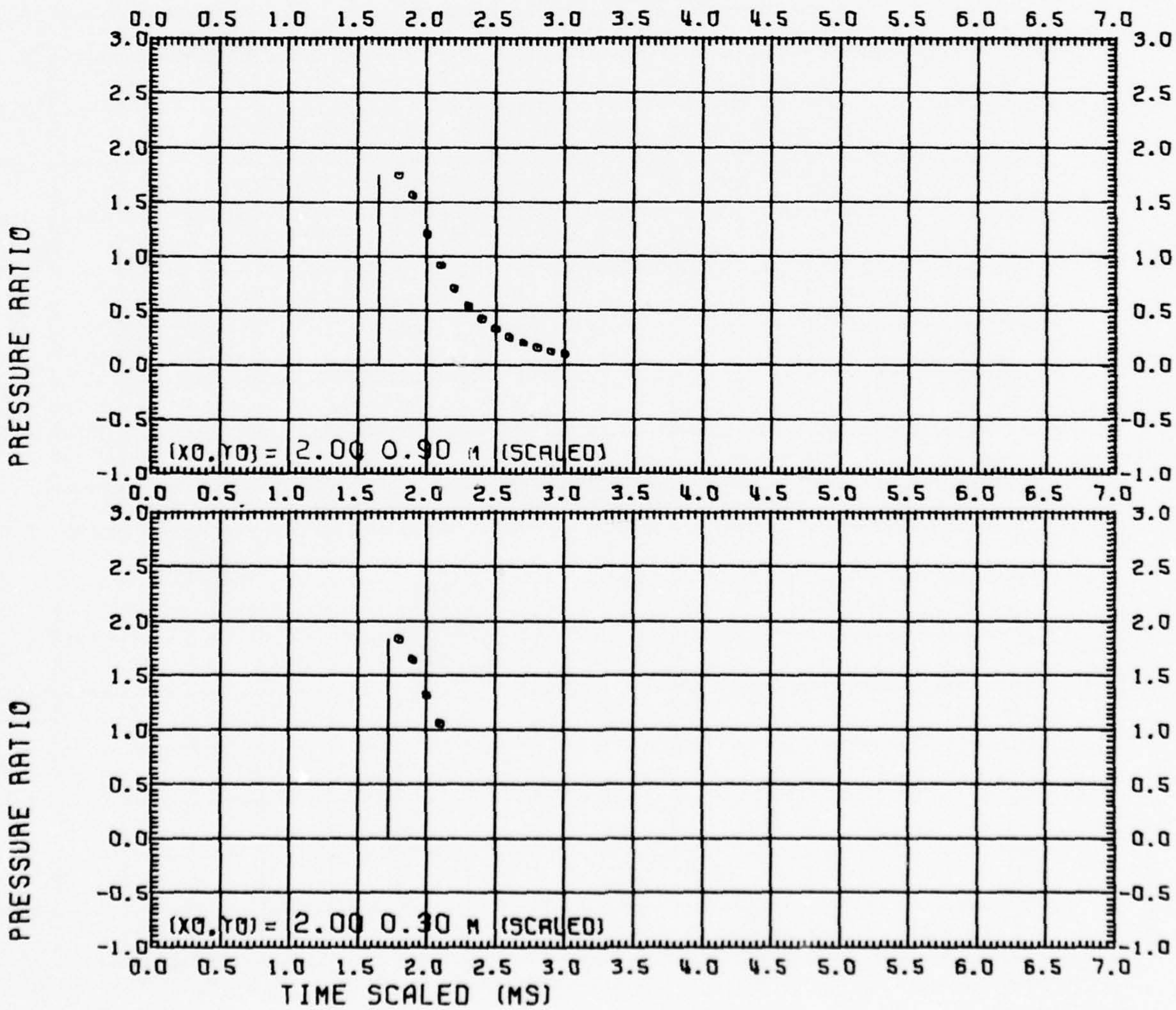


Fig. 26.2 DIPOLE WEST/9 DYNAMIC PRESSURE

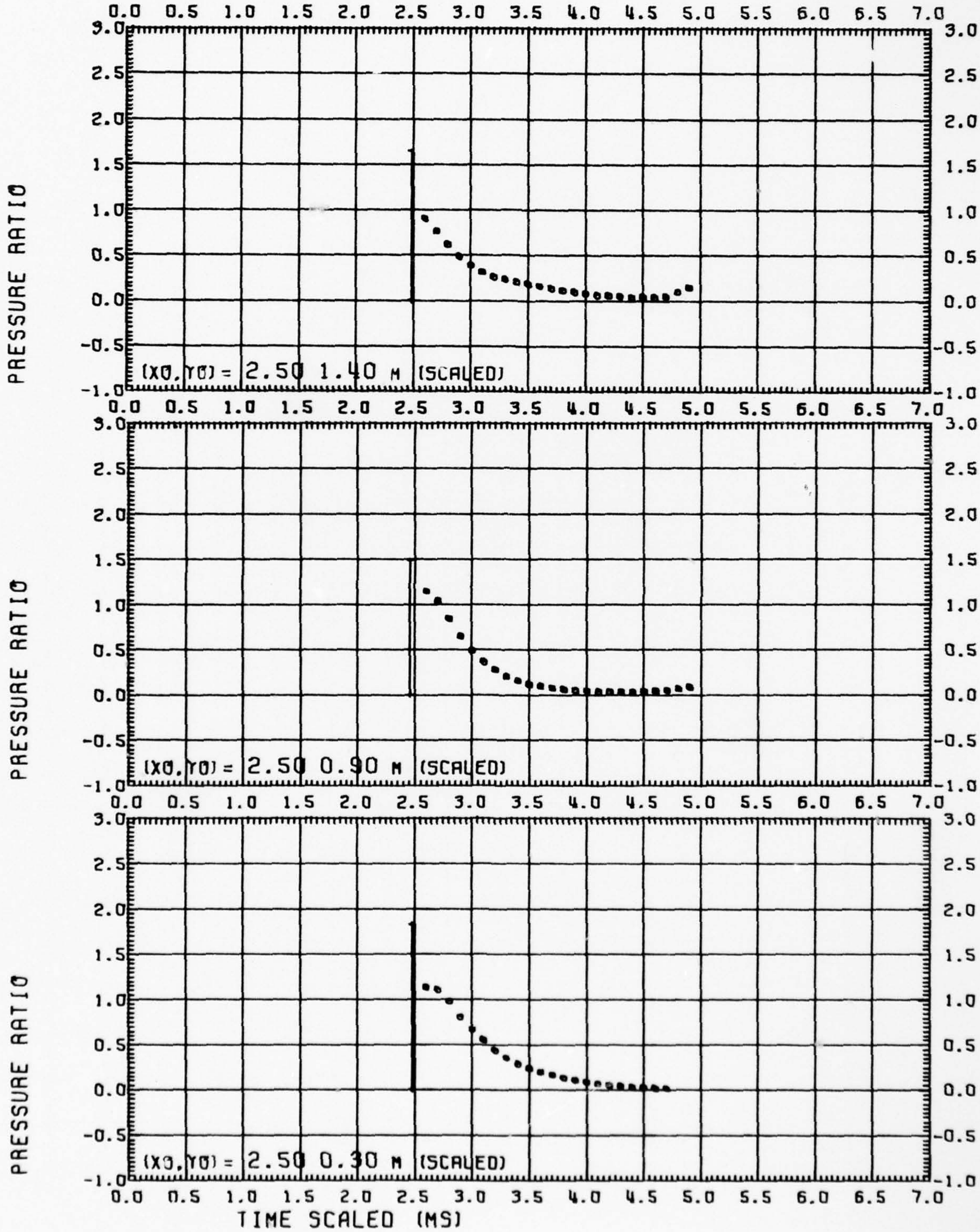
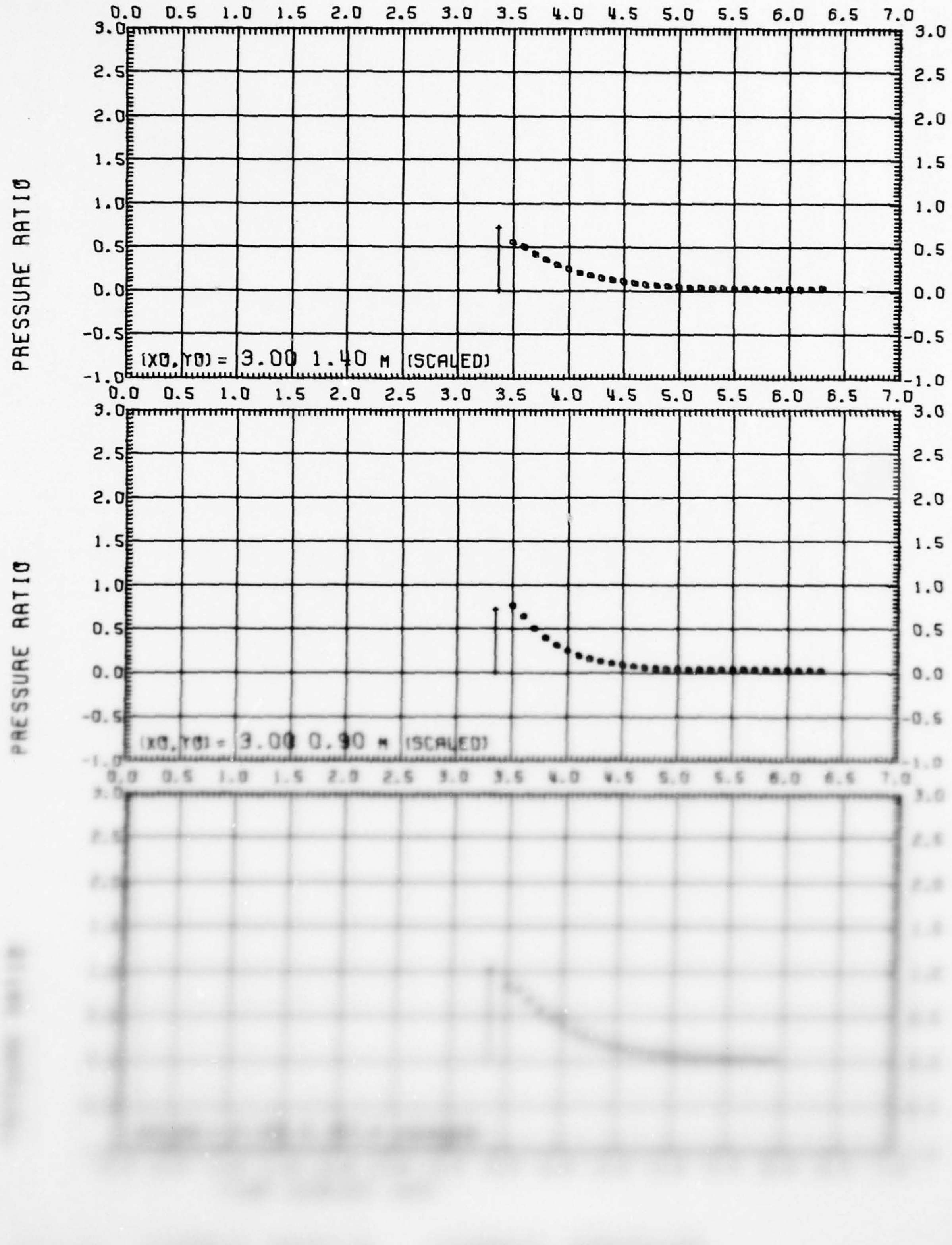
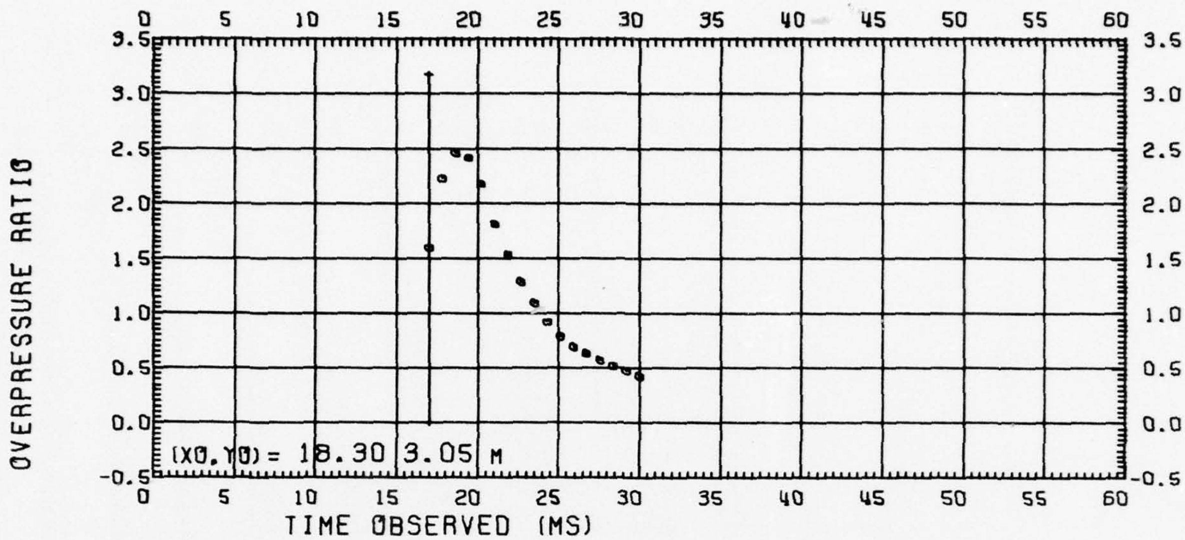


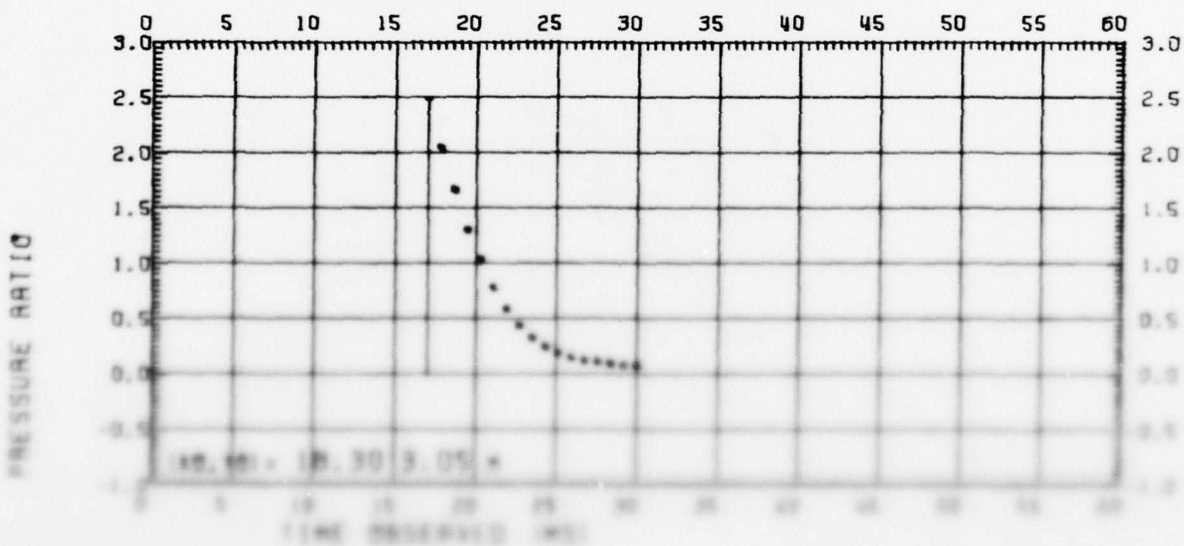
Fig. 26.3 DIPOLE WEST/9 DYNAMIC PRESSURE



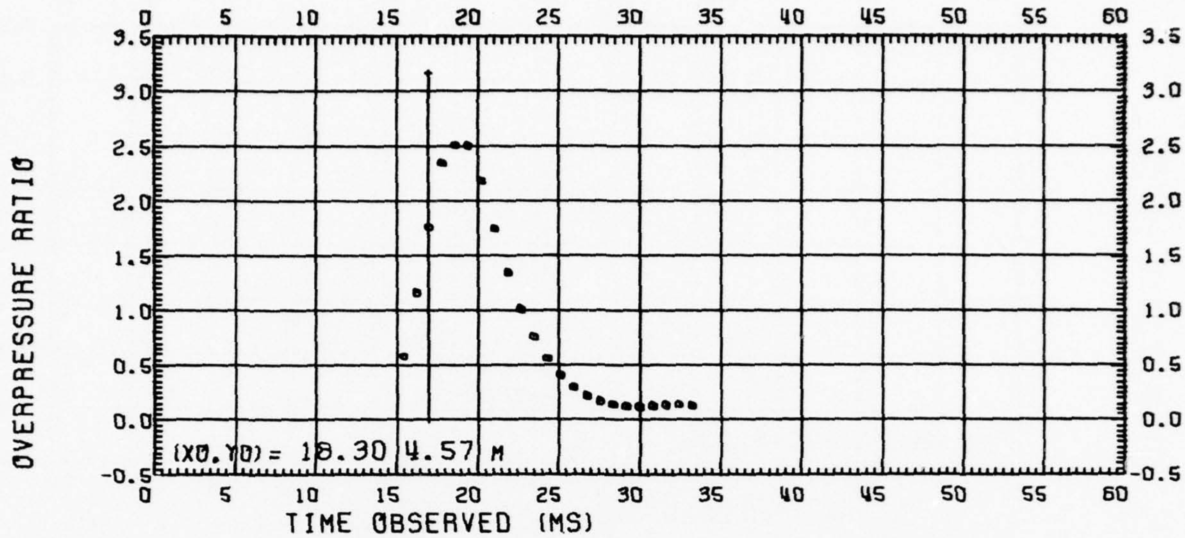
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0
3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
PRESSURE RATIO
(X0, Y0) = 3.00 1.40 M (SCALED)
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0
3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
PRESSURE RATIO
(X0, Y0) = 3.00 0.90 M (SCALED)



DIPOLE WEST/9 HYDROSTATIC OVERPRESSURE



DIPOLE WEST/9 DYNAMIC PRESSURE



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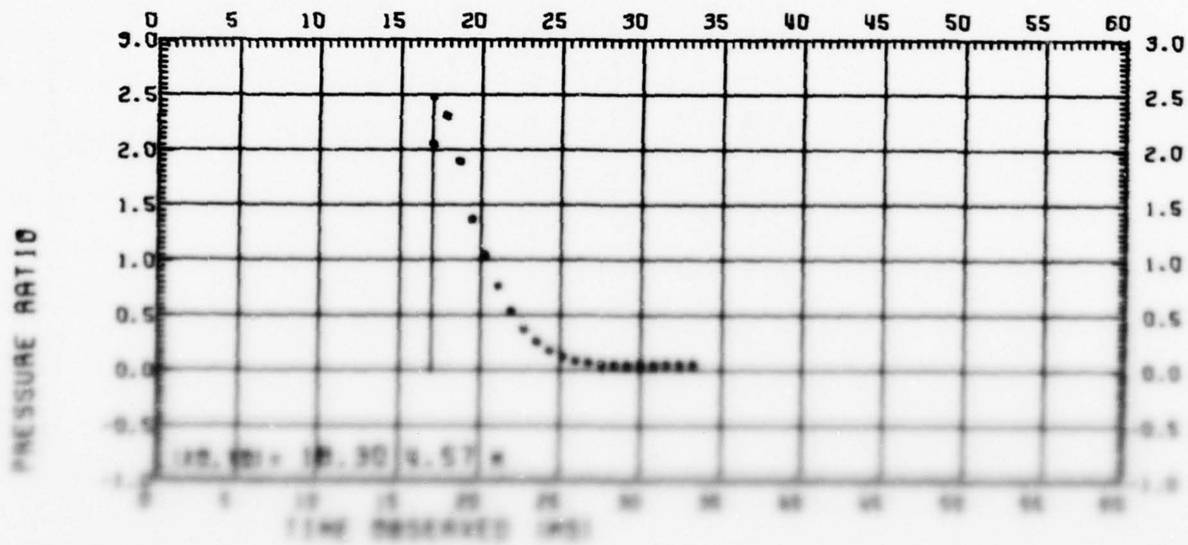

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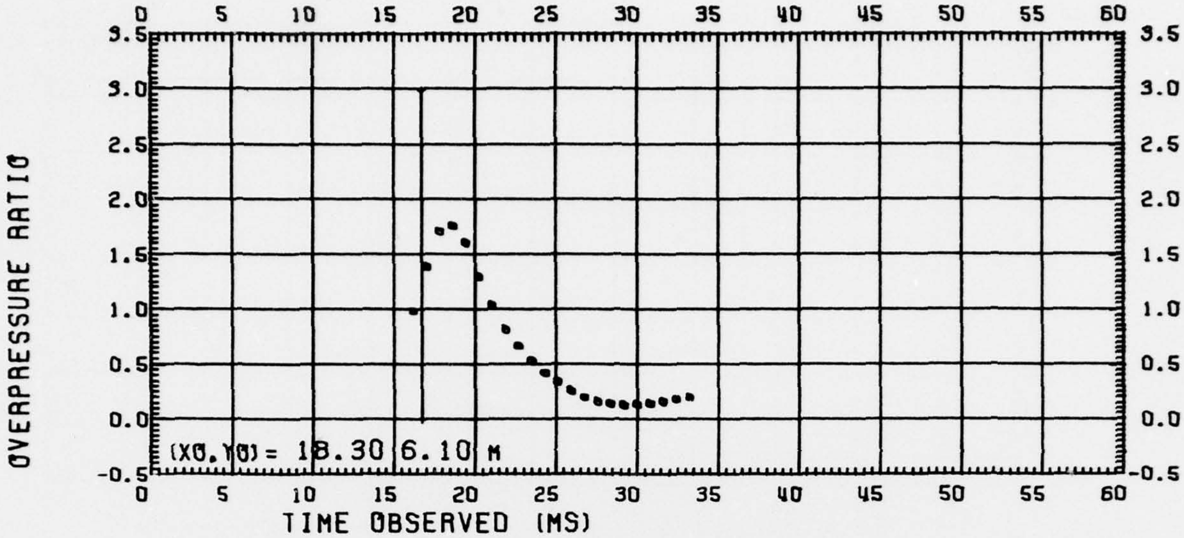

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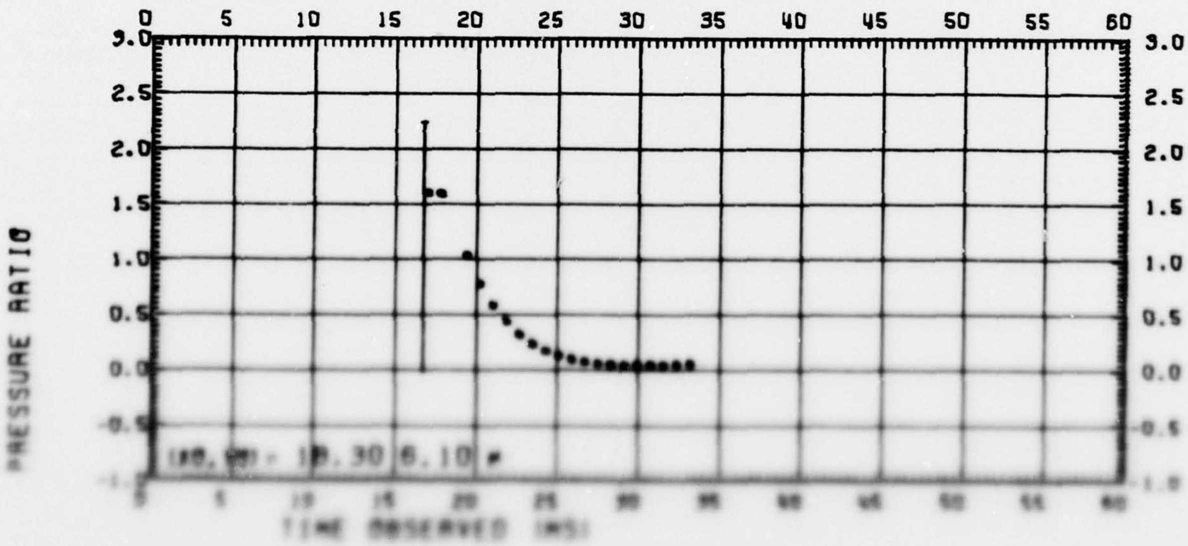
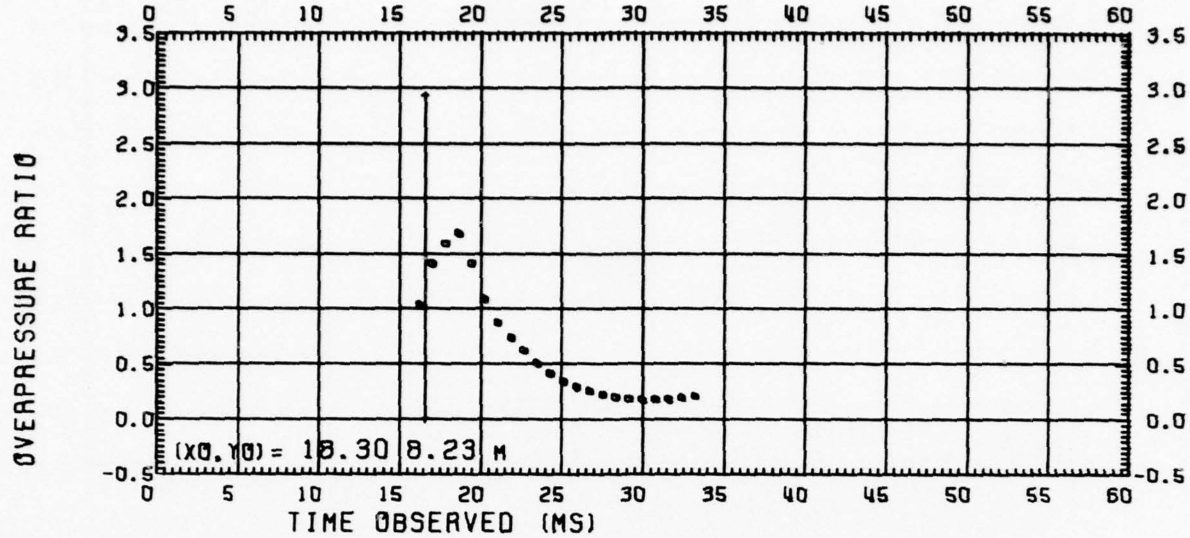
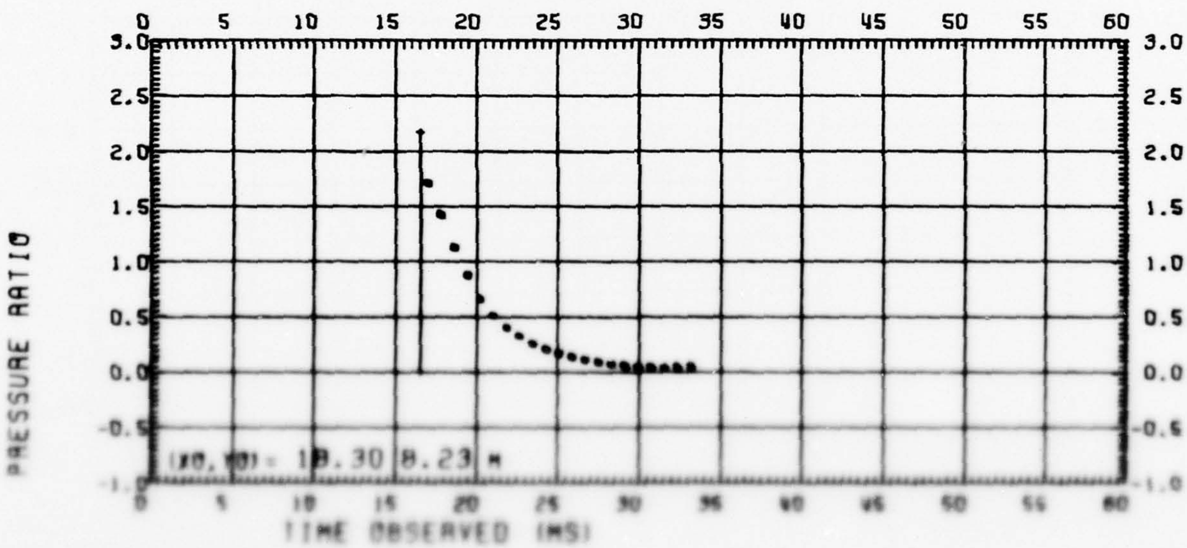


DIPOLE WEST/9 DYNAMIC PRESSURE

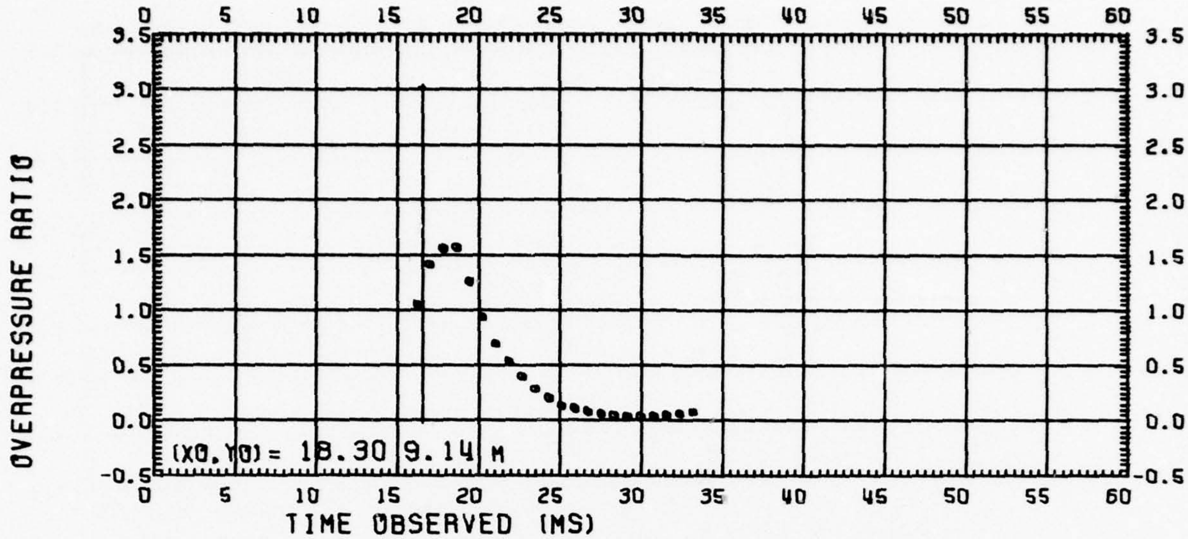


DIPOLE WEST/9 HYDROSTATIC OVERPRESSURE

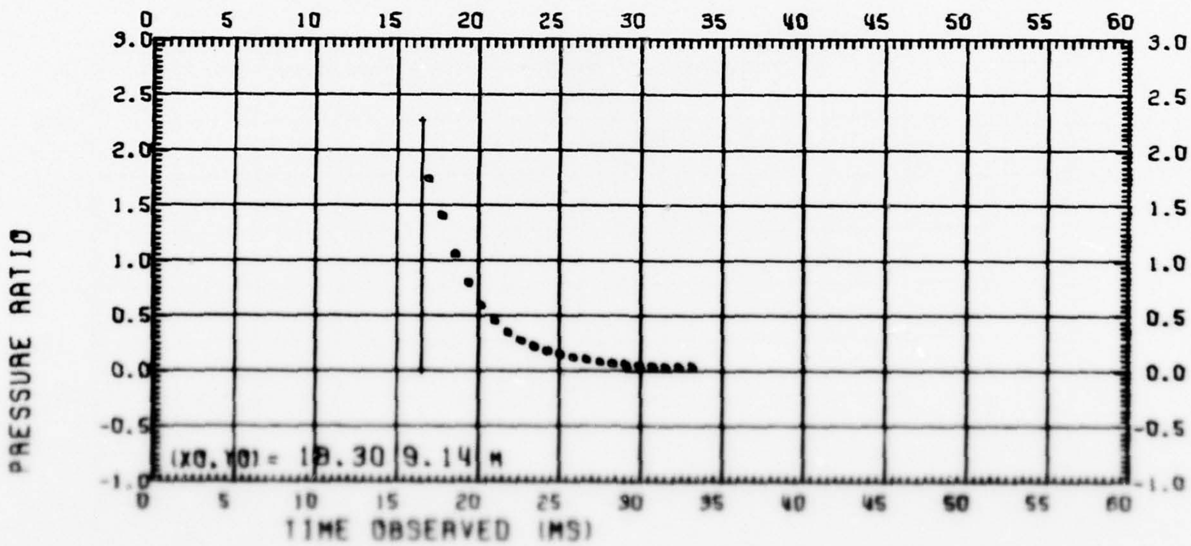


DIPOLE WEST/9 DYNAMIC PRESSURE

PRESSURE RESULTS AT GAUGE POSITION (X0,Y0) = 60 FT, 27 FT



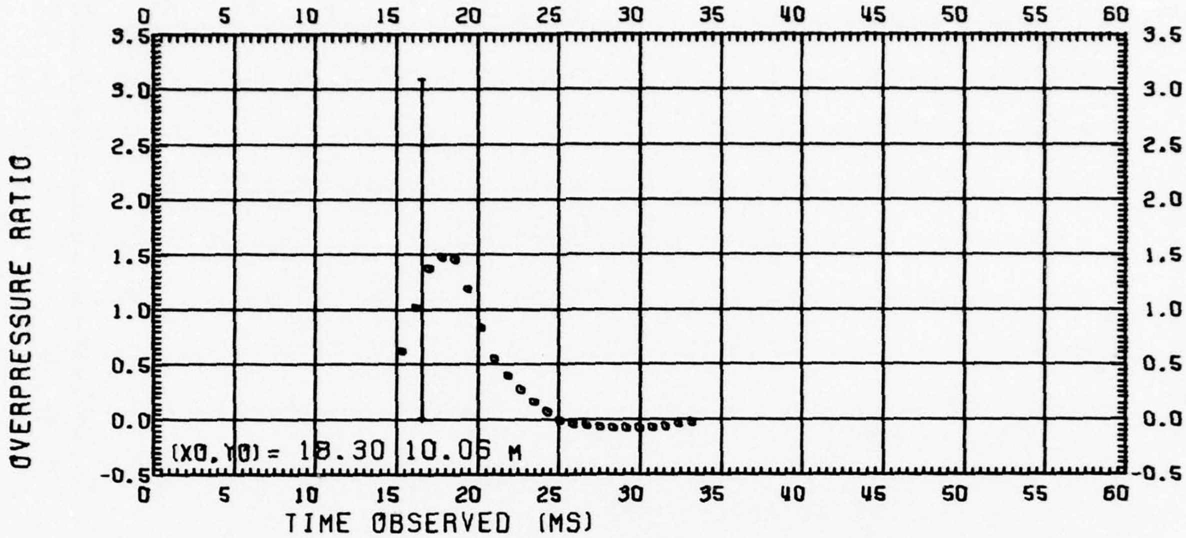
DIPOLE WEST/9 HYDROSTATIC OVERPRESSURE



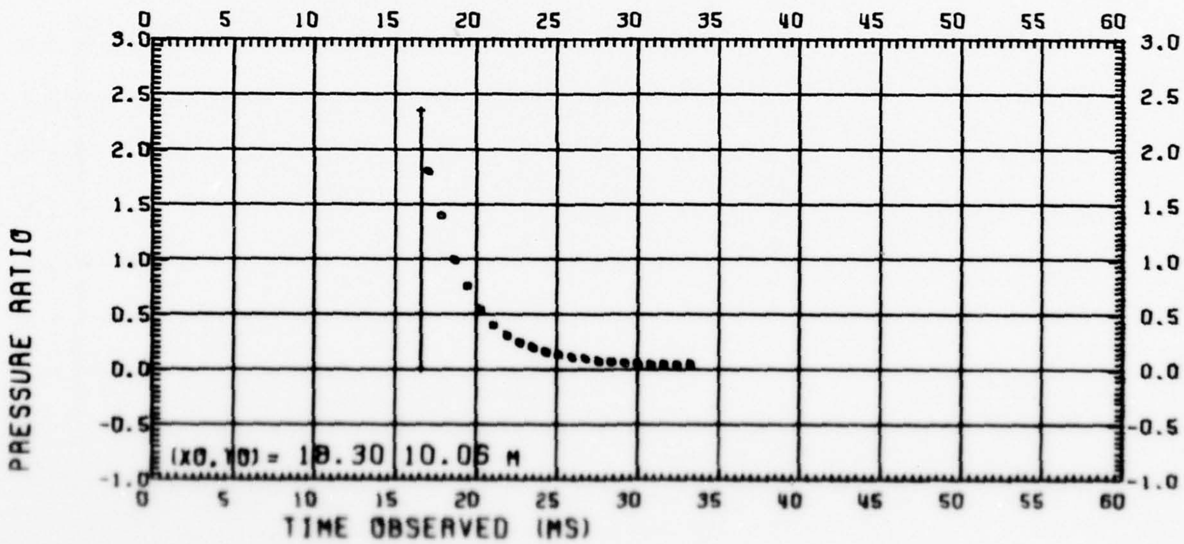
DIPOLE WEST/9 DYNAMIC PRESSURE

PRESSURE RESULTS AT GAUGE POSITION (X0,Y0) = 60 FT, 30 FT

Figure 27.3



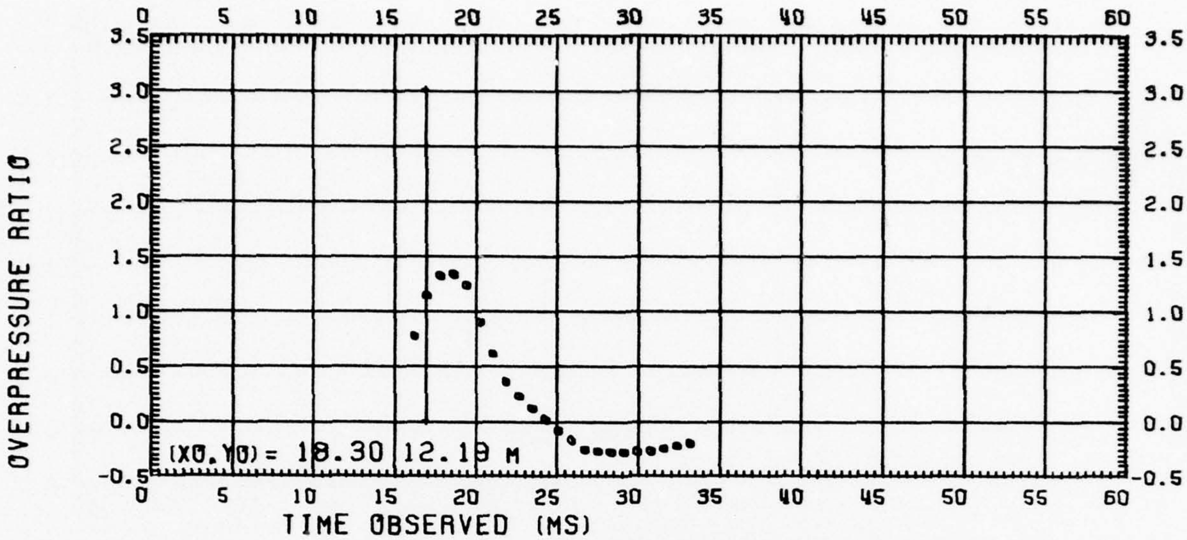
DIPOLE WEST/9 HYDROSTATIC OVERPRESSURE



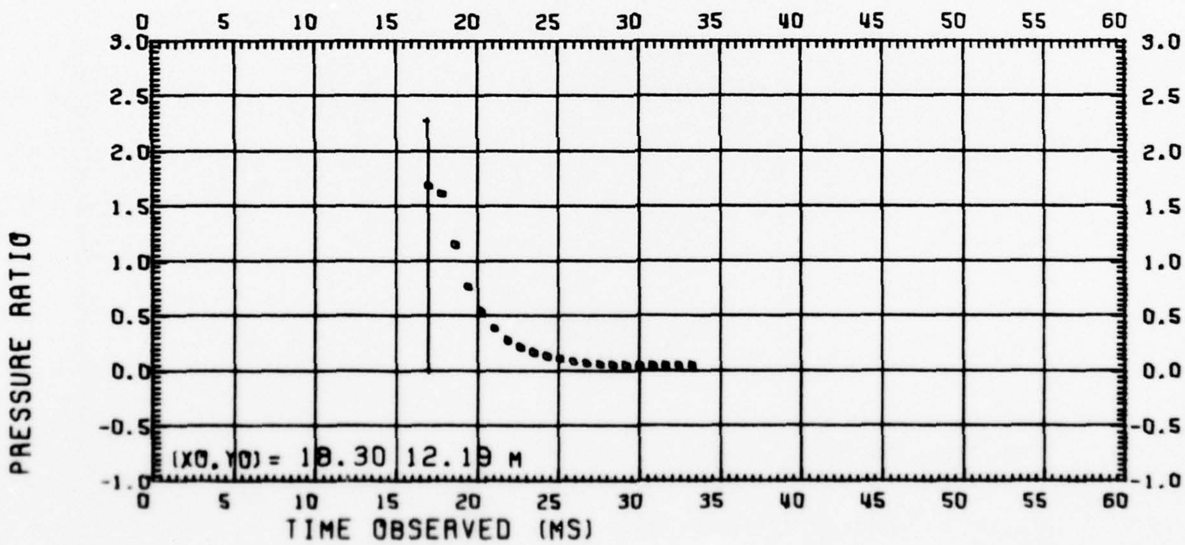
DIPOLE WEST/9 DYNAMIC PRESSURE

PRESSURE RESULTS AT GAUGE POSITION (X0,Y0) = 60 FT, 33 FT

Figure 27.6



DIPOLE WEST/9 HYDROSTATIC OVERPRESSURE



DIPOLE WEST/9 DYNAMIC PRESSURE

PRESSURE RESULTS AT GAUGE POSITION (XO,YO) = 60 FT, 40 FT

Figure 27.7

Table 1

SURVEY DATA LIST   DIPOLE WEST/9   /A770404

PT. NAME	BEARING	DISTANCE	COORD. E	COORD. N	COORD. H
G.ZERO	0. 0. 0	0.0	2000.000	2000.000	2316.320
G.ZERO B	167.36.16	1.063	2000.227	1998.961	2316.320
G.ZERO C			2000.241	1998.981	2316.320
B.CHARGE	167.36.16	1.063	2000.227	1998.961	2331.526
T.CHARGE	165.33.40	1.032	2000.255	1999.000	2361.748
MCP	180. 2.47	598.713	1998.289	1401.290	2313.750
WF5/295			2002.758	1385.147	2341.657
VP 1A	333.24.43	106.193	1952.648	2095.052	2348.823
VP 1B	333.24.40	106.422	1952.533	2095.250	2383.752
VP 2A	317.56.24	121.905	1918.429	2090.592	2348.640
VP 2B	317.48.50	122.407	1917.996	2090.878	2383.605
VP 3A	305.18.51	149.196	1878.448	2086.514	2348.376
VP 3B	305.12.35	149.142	1878.275	2086.176	2383.340
W 1	257.20.55	35.586	1965.259	1992.289	2318.150
W 2	260.21.43	70.394	1930.578	1988.344	2318.070
W 3	261.29.48	105.189	1895.935	1984.663	2317.350
300 W1	183.38.57	314.780	1979.184	1685.909	2330.730
300 W2	187.40.48	320.020	1956.569	1682.941	2330.280
1-20.10	84. 7.37	19.875	2019.774	2002.002	2326.369
1-20.15	83.52.20	19.864	2019.752	2002.103	2331.376
1-20.20	84.12.46	19.889	2019.792	2001.966	2336.381
1-20.27	83.53.34	19.841	2019.731	2002.082	2343.354
1-20.30	83.45. 6	19.836	2019.689	2002.150	2346.363
1-20.33	83.43.18	19.790	2019.673	2002.149	2349.316
1-20.40	84. 4.43	19.819	2019.717	2002.008	2356.412
1-30.10	69.25. 1	29.023	2027.171	2010.202	2326.517
1-30.15	68.48.13	29.890	2027.874	2010.791	2331.406
1-30.20	68.23. 2	30.020	2027.910	2011.056	2336.462
1-30.27	68.52.31	29.873	2027.880	2010.729	2343.442
1-30.30	68.54.25	29.879	2027.889	2010.722	2346.473
1-30.33	68.52.56	29.935	2027.951	2010.717	2349.432
1-30.40	68.36. 6	30.017	2027.950	2010.944	2356.023

BEARING IN DEGREES, MINUTES AND SECONDS, AND DISTANCE IN FEET
BEARING AND DISTANCE FROM G.ZERO UNLESS NOTED OTHERWISE
COORDINATES EAST AND NORTH AND ELEVATION IN FEET
NUMBER OF POINTS LISTED ABOVE IS 32

SUNDRY DATA LIST

T= 57.5 DEG F, P= 13.5 PSI, RH= 55.0 %, SVP= 12.1 MM, W= 1080.0 LBS
SCALING TO WO= 2.2 LBS USING FACTORS S= 8.111 AND C= 1.117 FT/MSEC
CALCULATED DISTANCE BETWEEN B.CHARGE AND G.ZERO B IS 15.206 FEET CH
CALCULATED DISTANCE BETWEEN B.CHARGE AND T.CHARGE IS 30.222 FEET CS
CALCULATED DISTANCE BETWEEN G.ZERO AND G.ZERO C IS 1.047 FEET
PENTOLITE SPHERES, FIRED 22 OCT 73, SIMULTANEOUSLY

Table 2

PHOTOGRAMMETRICS   DIPOLE WEST/9   WF5/295 30'   /A770404

CAMERA POSITION IS 2002.8 FEET EAST, 1385.1 FEET NORTH AND 2341.7 FEET ELEVATION
OPTICAL AXIS IS ORIENTED -6.763 DEGREES EAST OF NORTH AND 0.555 DEGREES UPWARD
OBJECT PLANE INCLUDES G.ZERO C AND IS 609.6 FEET FROM CAMERA ALONG OPTICAL AXIS

CALIBRATION DATA TRANSFORMED TO THE OBJECT PLANE IN FEET

PT. NAME	COORD. X	COORD. Y	SHIFT X	SHIFT Y	
B.CHARGE	69.685	-16.067	0.053	0.035	
T.CHARGE	69.777	14.190	-0.039	-0.016	
VP 1A	27.505	0.332	1.516	-0.090	
VP 1B	27.384	30.039	1.501	0.127	
VP 2A	-0.579	0.068	0.011	0.021	
VP 2B	-0.866	30.045	-0.040	0.010	
VP 3A	-34.604	0.034	-0.407	-0.177	
VP 3B	-34.984	29.864	-0.165	-0.037	
W 1	34.367	-29.508	0.000	-0.000	REFERENCE POINT P1
W 2	-0.734	-29.485	0.093	-0.097	
W 3	-35.544	-30.290	0.002	0.002	REFERENCE POINT P2
300 W1	24.277	-28.018	-0.004	0.008	REFERENCE POINT P3, P5
300 W2	-21.829	-27.967	-0.008	-0.975	REFERENCE POINT P4
1-20.10	89.902	-20.892	-0.528	-0.279	
1-20.15	89.793	-15.649	-0.428	-0.519	
1-20.20	89.771	-10.740	-0.353	-0.431	
1-20.27	89.741	-3.907	-0.384	-0.302	
1-20.30	89.694	-0.908	-0.385	-0.297	
1-20.33	89.743	2.157	-0.454	-0.415	
1-20.40	89.731	6.894	-0.413	-0.068	
1-30.10	97.906	-20.854	-1.385	0.008	
1-30.15	97.959	-15.671	-0.744	-0.340	
1-30.20	97.952	-10.730	-0.702	-0.293	
AVERAGES			-0.142	-0.179	

X-AXIS IS PARALLEL TO HORIZONTAL PLANE WITH ORIGIN WHERE OPTICAL AXIS INTERSECTS OBJECT PLANE. SHIFTS GIVE POINT POSITIONS WHICH ARE CALCULATED DIRECTLY FROM SURVEY DATA

MAXIMUM CALIBRATION ERROR SCALED= 0.080 FEET
MAXIMUM CAMERA ORIENTATION ERROR= 0.011 FEET

TOTAL ERRORS IN THE OBJECT PLANE= 0.091 FEET

Table 3

FILM TIMING DATA   DIPOLE WEST/9   WF5/295 30'   /A770404

STATIC ZERO = 3.90 CM
ACTUAL ZERO = 4.37 CM
FRAME LENGTH = 0.94625 CM

FRAME NO.	5-MSEC DISTANCE	FILM SPEED
-31	15.99 CM	3380./SEC
69	16.32 CM	3449./SEC
169	16.67 CM	3523./SEC
269	16.96 CM	3585./SEC
AVERAGES	16.48 CM	3484./SEC

STATIC ZERO IS CONSTANT FOR THE CAMERA
OTHER DATA ARE OBTAINED BY MEASUREMENT

FRAME TIMES IN MILLISECONDS FOR FRAMES 1 THROUGH 200 ARE:

1	0.4	2	0.7	3	1.0	4	1.3	5	1.6	6	1.9	7	2.2	8	2.5	9	2.8	10	3.1
11	3.4	12	3.7	13	4.0	14	4.3	15	4.6	16	4.8	17	5.1	18	5.4	19	5.7	20	6.0
21	6.3	22	6.6	23	6.9	24	7.2	25	7.5	26	7.8	27	8.1	28	8.4	29	8.7	30	8.9
31	9.2	32	9.5	33	9.8	34	10.1	35	10.4	36	10.7	37	11.0	38	11.3	39	11.6	40	11.9
41	12.2	42	12.4	43	12.7	44	13.0	45	13.3	46	13.6	47	13.9	48	14.2	49	14.5	50	14.8
51	15.1	52	15.4	53	15.6	54	15.9	55	16.2	56	16.5	57	16.8	58	17.1	59	17.4	60	17.7
61	18.0	62	18.3	63	18.6	64	18.8	65	19.1	66	19.4	67	19.7	68	20.0	69	20.3	70	20.6
71	20.9	72	21.2	73	21.5	74	21.7	75	22.0	76	22.3	77	22.6	78	22.9	79	23.2	80	23.5
81	23.8	82	24.1	83	24.3	84	24.6	85	24.9	86	25.2	87	25.5	88	25.8	89	26.1	90	26.4
91	26.7	92	26.9	93	27.2	94	27.5	95	27.8	96	28.1	97	28.4	98	28.7	99	29.0	100	29.3
101	29.5	102	29.8	103	30.1	104	30.4	105	30.7	106	31.0	107	31.3	108	31.6	109	31.8	110	32.1
111	32.4	112	32.7	113	33.0	114	33.3	115	33.6	116	33.8	117	34.1	118	34.4	119	34.7	120	35.0
121	35.3	122	35.6	123	35.9	124	36.1	125	36.4	126	36.7	127	37.0	128	37.3	129	37.6	130	37.9
131	38.1	132	38.4	133	38.7	134	39.0	135	39.3	136	39.6	137	39.9	138	40.1	139	40.4	140	40.7
141	41.0	142	41.3	143	41.6	144	41.9	145	42.1	146	42.4	147	42.7	148	43.0	149	43.3	150	43.6
151	43.9	152	44.1	153	44.4	154	44.7	155	45.0	156	45.3	157	45.6	158	45.8	159	46.1	160	46.4
161	46.7	162	47.0	163	47.3	164	47.6	165	47.8	166	48.1	167	48.4	168	48.7	169	49.0	170	49.3
171	49.5	172	49.8	173	50.1	174	50.4	175	50.7	176	51.0	177	51.2	178	51.5	179	51.8	180	52.1
181	52.4	182	52.7	183	52.9	184	53.2	185	53.5	186	53.8	187	54.1	188	54.4	189	54.6	190	54.9
191	55.2	192	55.5	193	55.8	194	56.0	195	56.3	196	56.6	197	56.9	198	57.2	199	57.5	200	57.7

DETONATION ZERO TIMING MARK MISSING FROM FILM. VALUE OF ACTUAL
ZERO USED ABOVE IS STATIC ZERO VALUE PLUS ONE-HALF FRAME LENGTH

Table 4

TIMES OF ARRIVAL   DIPOLE WEST/9   WF5/295   SMOKE PUFF GRID 1209   /A770404

AMBIENT TEMPERATURE T= 14.17 DEGREES CELSIUS
AMBIENT PRESSURE P= 93.02 KILOPASCALS
RELATIVE HUMIDITY RH= 55.0 PER CENT
VAPOUR PRESSURE VP= 0.89 KILOPASCALS
AMBIENT SPEED OF SOUND C= 340.469 METERS/SECOND
CHARGE WEIGHT W= 489.9 KILOGRAMS
CHARGE HEIGHT H= 4.63 METERS
SEPARATION #2 HS= 4.61 METERS
SACHS SCALING FACTOR S= 8.1111
SCALING TO CHARGE WEIGHT WO= 1.0 KILOGRAMS

INITIAL PUFF POSITIONS, TIMES OF ARRIVAL, AND PEAK PARTICLE VELOCITIES DERIVED BY TRAJECTORY FITTING

PUFF NUMBER	X-OBS METERS	Y-OBS METERS	T-OBS MSEC	X-SCAL METERS	Y-SCAL METERS	T-SCAL MSEC	U=DX/DT MACH NO	V=DY/DT MACH NO	PARTICLE VELOCITY	R-SCAL METERS	REGION CODE
1	8.009	17.443	4.258	0.987	2.150	0.525	1.347	0.986	1.670	1.082	2
2	7.874	15.984	3.378	0.971	1.971	0.417	0.590	0.157	0.524	1.006	2
3	7.646	14.368	3.378	0.943	1.771	0.417	2.618	-0.239	2.629	0.945	2
4	7.846	12.827	3.964	0.967	1.581	0.489	3.514	-0.003	3.514	0.975	2
5	7.538	11.290	3.671	0.929	1.392	0.453	1.730	1.151	2.078	0.981	2
6	7.385	9.795	3.964	0.910	1.208	0.489	3.324	0.766	3.411	0.913	5
7	7.612	8.420	3.671	0.938	1.038	0.453	0.894	0.584	1.068	0.944	4
8	7.404	6.904	3.378	0.913	0.851	0.417	2.190	0.686	2.295	0.955	1
9	7.523	5.383	3.378	0.928	0.664	0.417	2.877	-1.417	3.207	0.932	1
11	7.433	2.486	3.378	0.916	0.306	0.417	2.164	-0.644	2.257	0.954	1
12	7.335	0.854	3.671	0.904	0.105	0.453	0.267	-1.403	1.428	1.017	1
13	10.622	17.424	6.895	1.310	2.148	0.850	0.666	0.194	0.694	1.382	2
14	10.670	16.088	6.895	1.316	1.983	0.850	1.359	0.281	1.388	1.344	2
15	10.721	14.382	6.309	1.322	1.773	0.778	0.445	-0.158	0.472	1.323	2
16	10.509	12.835	6.309	1.296	1.582	0.778	1.513	-0.235	1.531	1.302	2
17	10.387	11.495	6.309	1.281	1.417	0.778	1.036	-0.410	1.114	1.313	2
18	10.316	9.966	6.309	1.272	1.229	0.778	1.643	-0.505	1.719	1.275	5
19	10.168	8.394	6.016	1.254	1.035	0.742	1.948	-0.004	1.948	1.258	4
20	10.373	6.859	6.309	1.279	0.846	0.778	1.677	-0.022	1.677	1.308	1
21	10.481	5.467	6.016	1.292	0.674	0.742	0.979	0.058	0.980	1.296	1
22	10.240	3.885	5.723	1.262	0.479	0.706	1.096	-0.401	1.167	1.266	1
23	10.176	2.465	5.723	1.255	0.304	0.706	0.618	0.079	0.822	1.283	1
24	11.409	1.066	8.065	1.407	0.131	0.995	1.684	-0.218	1.698	1.413	3
25	13.285	17.645	11.279	1.638	2.175	1.391	1.234	0.338	1.279	1.704	2
26	13.404	16.044	10.403	1.653	1.978	1.283	1.101	0.220	1.122	1.675	2
27	13.411	14.402	10.111	1.653	1.776	1.247	0.903	-0.197	0.924	1.655	2
29	13.286	11.323	9.819	1.638	1.396	1.211	1.649	0.174	1.658	1.658	5
30	13.933	10.088	10.695	1.718	1.244	1.319	1.541	0.031	1.541	1.721	5
31	13.341	8.305	9.819	1.645	1.024	1.211	1.956	-0.166	1.963	1.649	4
32	13.370	6.932	9.819	1.648	0.855	1.211	1.422	-0.488	1.503	1.673	4
33	13.373	5.464	10.111	1.649	0.674	1.247	1.068	-0.363	1.128	1.652	1
34	13.370	3.875	10.111	1.648	0.478	1.247	1.186	-0.053	1.188	1.651	1
35	13.542	2.343	10.403	1.670	0.289	1.283	1.421	0.539	1.520	1.694	3
36	14.390	1.036	11.862	1.774	0.128	1.463	1.296	0.078	1.298	1.779	3
37	15.612	17.350	13.903	1.925	2.139	1.715	0.377	0.178	0.417	1.973	2
38	15.470	15.957	13.611	1.907	1.967	1.679	0.905	-0.044	0.906	1.925	2
39	15.682	14.330	13.903	1.933	1.767	1.715	0.864	0.251	0.899	1.934	2
40	15.686	12.902	14.194	1.934	1.591	1.751	1.681	0.511	1.757	1.986	5
41	15.747	11.480	13.903	1.941	1.415	1.715	2.027	0.451	2.076	1.961	5
42	15.637	10.110	13.029	1.928	1.246	1.607	1.601	-0.142	1.607	1.931	5
43	15.532	8.568	12.154	1.915	1.056	1.499	1.154	-0.236	1.177	1.917	4
44	15.374	7.071	12.154	1.895	0.872	1.499	1.149	-0.391	1.213	1.914	4
45	15.441	5.653	12.737	1.904	0.697	1.571	1.163	-0.531	1.278	1.954	4
46	15.617	3.930	13.611	1.925	0.484	1.679	1.473	0.177	1.483	1.985	3
47	15.596	2.416	13.029	1.922	0.298	1.607	1.314	0.451	1.389	1.944	3
48	15.769	0.907	13.029	1.944	0.112	1.607	1.197	0.256	1.224	1.947	3
49	17.508	17.527	17.684	2.159	2.161	2.181	0.595	0.092	0.602	2.205	2
50	17.631	15.940	17.684	2.174	1.965	2.181	0.920	0.398	1.003	2.189	2
51	17.571	14.397	16.812	2.166	1.775	2.074	1.122	0.663	1.303	2.258	5
52	17.560	12.997	15.940	2.164	1.602	1.966	1.286	0.528	1.390	2.213	5
53	17.545	11.459	15.358	2.163	1.413	1.894	1.176	0.003	1.176	2.180	5
54	17.561	9.982	15.358	2.165	1.231	1.894	1.224	-0.085	1.227	2.167	5

Table 4, continued

55	17.573	8.658	15.358	2.167	1.067	1.894	1.146	-0.155	1.156	2.168	4
56	17.494	7.038	15.358	2.156	0.868	1.894	1.147	-0.316	1.190	2.173	4
57	17.385	5.446	15.358	2.143	0.671	1.894	1.045	-0.211	1.066	2.194	4
58	17.647	3.954	16.231	2.176	0.487	2.0[illegible]2	1.210	-0.176	1.223	2.230	3
59	17.418	2.201	15.649	2.147	0.271	1.93[illegible]	1.073	0.273	1.107	2.165	3
60	17.604	0.957	15.358	2.170	0.118	1.894	0.340	-0.326	0.476	2.174	3
61	19.662	17.535	21.743	2.424	2.162	2.682	0.811	0.349	0.883	2.466	2
62	19.895	15.980	21.454	2.453	1.970	2.646	1.040	0.315	1.067	2.590	5
63	19.673	14.450	19.715	2.425	1.781	2.432	0.909	0.313	0.961	2.509	5
64	19.626	12.803	19.425	2.420	1.578	2.396	1.198	0.361	1.251	2.459	5
65	19.896	11.541	19.425	2.453	1.423	2.396	0.976	0.246	1.005	2.469	5
66	19.717	9.742	18.845	2.431	1.201	2.325	0.929	0.167	0.943	2.432	5
67	19.682	8.432	18.845	2.427	1.040	2.325	0.943	-0.202	0.964	2.429	4
68	19.662	6.931	18.845	2.424	0.854	2.325	1.067	-0.205	1.086	2.441	4
69	19.895	5.434	19.425	2.453	0.670	2.396	0.906	0.006	0.906	2.497	4
70	19.607	3.657	19.135	2.442	0.451	2.360	1.172	-0.122	1.179	2.483	3
71	19.557	2.345	18.845	2.411	0.289	2.325	0.948	-0.118	0.956	2.428	3
72	19.854	0.862	19.135	2.448	0.106	2.360	0.747	0.006	0.748	2.450	3
73	21.740	17.494	25.214	2.680	2.157	3.110	0.692	0.358	0.779	2.867	5
74	21.778	16.045	24.058	2.685	1.978	2.968	0.711	0.305	0.774	2.813	5
75	21.881	14.551	23.480	2.698	1.794	2.896	0.903	0.167	0.918	2.776	5
76	21.953	12.882	23.480	2.707	1.588	2.896	0.718	0.307	0.781	2.744	5
77	21.848	11.500	22.901	2.694	1.418	2.825	1.041	0.041	1.041	2.708	5
78	21.786	9.955	22.612	2.686	1.227	2.789	1.072	-0.128	1.080	2.687	5
79	21.893	8.391	22.612	2.699	1.034	2.789	0.831	-0.046	0.833	2.701	4
80	21.759	6.863	22.612	2.683	0.846	2.789	1.007	0.034	1.007	2.699	4
81	21.819	5.419	22.612	2.690	0.668	2.789	1.168	0.035	1.168	2.731	4
82	21.846	4.033	22.612	2.693	0.497	2.789	1.097	-0.049	1.098	2.739	3
83	21.776	2.342	22.612	2.685	0.289	2.789	0.985	-0.292	1.028	2.700	3
84	22.062	0.878	23.480	2.720	0.108	2.896	0.864	-0.215	0.890	2.722	3
85	24.016	17.472	29.538	2.961	2.154	3.644	0.716	0.202	0.744	3.130	5
86	23.865	16.168	28.675	2.942	1.993	3.537	0.692	0.245	0.734	3.064	5
87	23.936	14.501	27.522	2.951	1.788	3.395	0.808	0.207	0.834	3.021	5
88	24.083	12.818	27.234	2.969	1.580	3.359	0.844	0.065	0.847	3.002	5
89	23.946	11.343	26.657	2.952	1.398	3.288	0.833	-0.022	0.833	2.964	5
90	24.235	9.743	26.657	2.988	1.201	3.288	0.680	-0.134	0.693	2.989	5
91	23.917	8.387	26.657	2.949	1.034	3.288	0.900	-0.041	0.901	2.951	4
92	24.041	7.054	26.657	2.964	0.870	3.288	0.948	-0.067	0.951	2.976	4
93	24.036	5.414	26.657	2.960	0.667	3.288	1.103	-0.084	1.107	2.997	4
94	24.072	3.766	26.657	2.968	0.464	3.288	0.967	-0.158	0.980	3.004	3
95	24.034	2.211	26.657	2.963	0.273	3.288	0.844	-0.224	0.873	2.976	3
96	23.990	0.890	26.657	2.958	0.110	3.288	0.679	-0.297	0.742	2.960	3
97	25.530	17.343	32.414	3.148	2.138	3.998	0.706	0.193	0.732	3.302	5
98	25.571	15.966	31.839	3.153	1.968	3.927	0.750	0.247	0.790	3.260	5
99	25.546	14.380	30.689	3.149	1.773	3.786	0.655	0.021	0.655	3.213	5
100	25.282	12.701	28.963	3.117	1.566	3.573	0.598	0.130	0.611	3.146	5
101	25.296	11.418	28.963	3.117	1.408	3.573	0.555	-0.088	0.562	3.129	5
102	25.520	9.731	29.538	3.146	1.200	3.644	0.713	-0.038	0.714	3.147	5
103	25.535	8.404	28.963	3.148	1.036	3.573	0.643	0.062	0.646	3.150	4
104	25.268	6.874	28.675	3.115	0.848	3.537	0.904	0.128	0.913	3.129	4
105	25.342	5.331	28.675	3.124	0.657	3.537	0.953	-0.012	0.954	3.161	4
106	25.476	3.887	28.963	3.141	0.479	3.573	0.836	0.012	0.836	3.177	3
107	25.530	2.298	28.963	3.144	0.283	3.573	0.739	-0.250	0.780	3.157	3
108	25.595	0.875	29.538	3.155	0.108	3.644	0.736	-0.084	0.741	3.157	3

X IS DISTANCE MEASURED HORIZONTALLY FROM GROUND ZERO,
Y IS DISTANCE MEASURED VERTICALLY ABOVE GROUND ZERO, AND
T IS TIME-OF-ARRIVAL INDICATED BY THE PUFF TRAJECTORY.
VELOCITIES ARE DERIVATIVES AT THE TIME OF ARRIVAL,
AND ARE EXPRESSED IN MACH UNITS RELATIVE TO C ABOVE.
R IS A RADIUS CALCULATED ACCORDING TO REGIONS DEFINED
ON BASIS OF FIRST SHOCK FRONT PASSING, CODED USING:

1= PRIMARY FRONT FROM LOWER CHARGE
2= PRIMARY FRONT FROM UPPER CHARGE
3= MACH STEM AT GROUND SURFACE
4= MACH STEM BELOW INTERACTION PLANE
5= MACH STEM ABOVE INTERACTION PLANE

SCALED TIME= OBSERVED TIME MULTIPLIED BY (C/CO)/S, WHERE CO= 340.292 METERS/SECOND
AND SCALED DISTANCE= OBSERVED DISTANCE DIVIDED BY S= CUBE ROOT OF (W/WO)*(PO/P),
WHERE PO= 101.325 KILOPASCALS. (W, WO, AND P ARE DEFINED ABOVE.)
SCALED EVENT= STANDARD CHARGE WO IN ATMOSPHERE WHERE CO AND PO ARE AMBIENT (TO= 15 DEGREES CELSIUS).
VELOCITY EXPRESSED IN MACH UNITS IS INVARIANT UNDER SCALING.

Table 5.1

SHOCK FRONT DATA   DIPOLE WEST/9   WF5/295   SMOKE PUFF GRID 1209   R1 /A770404

PRIMARY FRONT FROM LOWER CHARGE

AMBIENT TEMPERATURE T= 14.17 DEGREES CELSIUS
AMBIENT PRESSURE P= 93.02 KILOPASCALS
RELATIVE HUMIDITY RH= 55.0 PER CENT
VAPOUR PRESSURE VP= 0.99 KILOPASCALS
AMBIENT SPEED OF SOUND C= 340.469 METERS/SECOND
CHARGE WEIGHT W= 489.9 KILOGRAMS
CHARGE HEIGHT H= 4.63 METERS
SEPARATION +2 HS= 4.61 METERS
SACHS SCALING FACTOR S= 8.1111
SCALING TO CHARGE WEIGHT WO= 1.0 KILOGRAMS

SHOCK FRONT DATA COMPUTED FROM PARTICLE TRAJECTORY TIMES OF ARRIVAL

T-OBS MSEC	R-OBS METERS	R-FIT METERS	DIFFERENCE METERS	T-SCAL MSEC	R-SCAL METERS	SHOCK VELOCITY	PRESSURE RATIO	PRESSURE KPA	PARTICLE VELOCITY	DENSITY RATIO	PUFF NUMBER
3.378	7.738	7.726	-0.012	0.417	0.953	3.907	16.640	1547.816	3.042	4.519	11
3.378	7.744	7.726	-0.018	0.417	0.953	3.907	16.640	1547.816	3.042	4.519	8
3.378	7.560	7.726	0.166	0.417	0.953	3.907	16.640	1547.816	3.042	4.519	9
3.671	8.252	8.105	-0.147	0.453	0.999	3.678	14.616	1359.550	2.838	4.381	12
5.723	10.405	10.265	-0.140	0.706	1.266	2.636	6.940	645.574	1.881	3.489	23
5.723	10.267	10.265	-0.002	0.706	1.266	2.636	6.940	645.574	1.881	3.489	22
6.016	10.514	10.523	0.009	0.742	1.297	2.537	6.343	589.990	1.786	3.377	21
6.309	10.609	10.771	0.162	0.778	1.328	2.446	5.813	540.749	1.698	3.268	20
10.111	13.392	13.386	-0.006	1.247	1.650	1.700	2.203	204.953	0.926	2.197	34
10.111	13.399	13.386	-0.013	1.247	1.650	1.700	2.203	204.953	0.926	2.197	33

T IS TIME-OF-ARRIVAL AND R IS RADIAL PUFF POSITION. RADIUS VALUES ARE FITTED USING RFIT=A+B*T+C*LOG(1+T).
SHOCK AND PARTICLE VELOCITIES ARE EXPRESSED IN MACH UNITS, RELATIVE TO THE AMBIENT SOUND SPEED C ABOVE.
PRESSURE IS PEAK OVERPRESSURE RATIO (PMAX-P)/P, AND PEAK OVERPRESSURE (PMAX-P) IN KILOPASCALS OBSERVED,
WHERE P IS AMBIENT PRESSURE. DENSITY IS EXPRESSED AS A RATIO, RELATIVE TO THE AMBIENT DENSITY D.

SCALED TIME= OBSERVED TIME MULTIPLIED BY (C/CO)/S, WHERE CO= 340.292 METERS/SECOND
AND SCALED DISTANCE= OBSERVED DISTANCE DIVIDED BY S= CUBE ROOT OF (W/WO)*(PO/P),
WHERE PO= 101.325 KILOPASCALS. (W, WO, AND P ARE DEFINED ABOVE.)
SCALED EVENT= STANDARD CHARGE WO IN ATMOSPHERE WHERE CO AND PO ARE AMBIENT (TO= 15 DEGREES CELSIUS).
VELOCITY, PRESSURE, AND DENSITY, EXPRESSED AS RATIOS, ARE INVARIANT UNDER SCALING.

AD-A053 420 GENERAL ELECTRIC CO ALBUQUERQUE N MEX TEMPO F/G 18/3
PHOTOGRAMMETRY OF THE PARTICLE TRAJECTORIES ON DIPOLE WEST SHOT--ETC(U)
OCT 77 J M DEWEY, D J MCMILLIN, D TRILL DNA001-77-C-0305
UNCLASSIFIED DNA-4326F-2 NL

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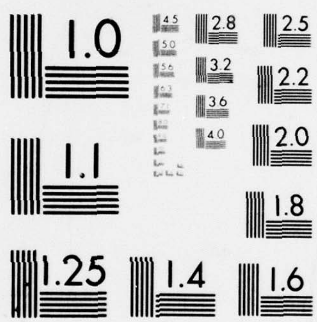

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Table 5.2

SHOCK FRONT DATA   DIPOLE WEST/9   WF5/295   SMOKE PUFF GRID 1209   R2 /A77C404

PRIMARY FRONT FROM UPPER CHARGE

AMBIENT TEMPERATURE T= 14.17 DEGREES CELSIUS
AMBIENT PRESSURE P= 93.02 KILOPASCALS
RELATIVE HUMIDITY RH= 55.0 PER CENT
VAPOUR PRESSURE VP= 0.89 KILOPASCALS
AMBIENT SPEED OF SOUND C= 340.469 METERS/SECOND
CHARGE WEIGHT W= 489.9 KILOGRAMS
CHARGE HEIGHT H= 4.63 METERS
SEPARATION +2 HS= 4.61 METERS
SACHS SCALING FACTOR S= 8.1111
SCALING TO CHARGE WEIGHT WO= 1.0 KILOGRAMS

SHOCK FRONT DATA COMPUTED FROM PARTICLE TRAJECTORY TIMES OF ARRIVAL

T-OBS MSEC	R-OBS METERS	R-FIT METERS	DIFFERENCE METERS	T-SCAL MSEC	R-SCAL METERS	SHOCK VELOCITY	PRESSURE RATIO	PRESSURE KPA	PARTICLE VELOCITY	DENSITY RATIO	PUFF NUMBER
3.378	7.664	7.739	0.075	0.417	0.954	3.391	12.250	1139.469	2.580	4.182	3
3.378	8.159	7.739	-0.419	0.417	0.954	3.391	12.250	1139.469	2.580	4.182	2
3.671	7.960	8.071	0.111	0.453	0.995	3.243	11.104	1032.836	2.446	4.067	5
3.964	7.912	8.388	0.476	0.489	1.034	3.112	10.135	942.775	2.326	3.957	4
4.258	8.779	8.692	-0.087	0.525	1.072	2.997	9.309	865.882	2.219	3.854	1
6.309	10.650	10.571	-0.079	0.778	1.303	2.446	5.811	540.483	1.697	3.268	17
6.309	10.557	10.571	0.013	0.778	1.303	2.446	5.811	540.483	1.697	3.268	16
6.309	10.735	10.571	-0.164	0.778	1.303	2.446	5.811	540.483	1.697	3.268	15
6.895	11.208	11.047	-0.160	0.850	1.362	2.341	5.226	486.077	1.595	3.137	13
6.895	10.903	11.047	0.144	0.850	1.362	2.341	5.226	486.077	1.595	3.137	14
10.111	13.423	13.379	-0.044	1.247	1.649	1.962	3.326	309.348	1.211	2.610	27
10.403	13.583	13.573	-0.011	1.283	1.673	1.939	3.217	299.277	1.186	2.574	26
11.279	13.817	14.140	0.323	1.391	1.743	1.874	2.930	272.569	1.117	2.475	25
13.611	15.613	15.571	-0.042	1.679	1.920	1.740	2.365	219.943	0.971	2.262	38
13.903	15.690	15.743	0.054	1.715	1.941	1.726	2.309	214.750	0.955	2.240	39
13.903	16.001	15.743	-0.257	1.715	1.941	1.726	2.309	214.750	0.955	2.240	37
17.684	17.755	17.867	0.112	2.181	2.203	1.586	1.767	164.376	0.796	2.008	50
17.684	17.891	17.867	-0.024	2.181	2.203	1.586	1.767	164.376	0.796	2.008	49
21.743	20.005	19.985	-0.020	2.682	2.464	1.487	1.414	131.489	0.679	1.840	61

T IS TIME-OF-ARRIVAL AND R IS RADIAL PUFF POSITION. RADIUS VALUES ARE FITTED USING RFIT=A+B*T+C*LOG(1+T).
SHOCK AND PARTICLE VELOCITIES ARE EXPRESSED IN MACH UNITS, RELATIVE TO THE AMBIENT SOUND SPEED C ABOVE.
PRESSURE IS PEAK OVERPRESSURE RATIO (PMAX-P)/P, AND PEAK OVERPRESSURE (PMAX-P) IN KILOPASCALS OBSERVED,
WHERE P IS AMBIENT PRESSURE. DENSITY IS EXPRESSED AS A RATIO, RELATIVE TO THE AMBIENT DENSITY D.

SCALED TIME= OBSERVED TIME MULTIPLIED BY (C/CO)/S, WHERE CO= 340.292 METERS/SECOND
AND SCALED DISTANCE= OBSERVED DISTANCE DIVIDED BY S= CUBE ROOT OF (W/WO)*(PO/P),
WHERE PO= 101.325 KILOPASCALS. (W, WO, AND P ARE DEFINED ABOVE.)
SCALED EVENT= STANDARD CHARGE WO IN ATMOSPHERE WHERE CO AND PO ARE AMBIENT (TO= 15 DEGREES CELSIUS).
VELOCITY, PRESSURE, AND DENSITY, EXPRESSED AS RATIOS, ARE INVARIANT UNDER SCALING.

Table 5.3

SHOCK FRONT DATA   DIPOLE WEST/9   WF5/295   SMOKE PUFF GRID 1209   R4 /A/70404

MACH STEM BELOW INTERACTION PLANE

AMBIENT TEMPERATURE T= 14.17 DEGREES CELSIUS
AMBIENT PRESSURE P= 93.02 KILOPASCALS
RELATIVE HUMIDITY RH= 55.0 PER CENT
VAPOUR PRESSURE VP= 0.89 KILOPASCALS
AMBIENT SPEED OF SOUND C= 340.469 METERS/SECOND
CHARGE WEIGHT W= 489.9 KILOGRAMS
CHARGE HEIGHT H= 4.63 METERS
SEPARATION +2 HS= 4.61 METERS
SACHS SCALING FACTOR S= 8.1111
SCALING TO CHARGE WEIGHT WO= 1.0 KILOGRAMS

SHOCK FRONT DATA COMPUTED FROM PARTICLE TRAJECTORY TIMES OF ARRIVAL

T-OBS MSEC	R-OBS METERS	R-FIT METERS	DIFFERENCE METERS	T-SCAL MSEC	R-SCAL METERS	SHOCK VELOCITY	PRESSURE RATIO	PRESSURE KPA	PARTICLE VELOCITY	DENSITY RATIO	PUFF NUMBER
3.671	7.656	7.581	-0.075	0.453	0.935	3.898	16.560	1540.393	3.035	4.514	7
6.016	10.203	10.274	0.070	0.742	1.267	2.974	9.155	851.588	2.199	3.834	19
9.819	13.568	13.644	0.076	1.211	1.682	2.328	5.155	479.549	1.582	3.121	32
9.819	13.373	13.644	0.271	1.211	1.682	2.328	5.155	479.549	1.582	3.121	31
12.154	15.526	15.404	-0.122	1.499	1.899	2.116	4.058	377.422	1.370	2.835	44
12.154	15.546	15.404	-0.142	1.499	1.899	2.116	4.058	377.422	1.370	2.835	43
12.737	15.853	15.820	-0.033	1.571	1.950	2.074	3.854	358.481	1.327	2.775	45
15.358	17.795	17.599	-0.195	1.894	2.170	1.924	3.152	293.161	1.170	2.552	57
15.358	17.583	17.599	0.016	1.894	2.170	1.924	3.152	293.161	1.170	2.552	55
15.358	17.623	17.599	-0.023	1.894	2.170	1.924	3.152	293.161	1.170	2.552	56
16.845	19.798	19.794	-0.003	2.325	2.440	1.785	2.552	237.360	1.021	2.336	68
16.845	19.698	19.794	0.096	2.325	2.440	1.785	2.552	237.360	1.021	2.336	67
19.425	20.256	20.145	-0.111	2.396	2.484	1.767	2.475	230.238	1.001	2.306	69
22.612	22.150	22.013	-0.137	2.789	2.714	1.682	2.132	198.322	0.906	2.167	81
22.612	21.909	22.013	0.103	2.789	2.714	1.682	2.132	198.322	0.906	2.167	79
22.612	21.889	22.013	0.124	2.789	2.714	1.682	2.132	198.322	0.906	2.167	83
26.657	24.309	24.269	-0.040	3.288	2.992	1.602	1.826	169.838	0.814	2.034	93
26.657	23.932	24.269	0.337	3.288	2.992	1.602	1.826	169.838	0.814	2.034	91
26.657	24.140	24.269	0.129	3.288	2.992	1.602	1.826	169.838	0.814	2.034	92
28.675	25.642	25.358	-0.284	3.537	3.126	1.570	1.708	158.916	0.777	1.981	105
28.675	25.379	25.358	-0.021	3.537	3.126	1.570	1.708	158.916	0.777	1.981	104
28.963	25.549	25.511	-0.038	3.573	3.145	1.566	1.693	157.494	0.772	1.974	103

T IS TIME-OF-ARRIVAL AND R IS RADIAL PUFF POSITION. RADIUS VALUES ARE FITTED USING RFIT=A+B*T+C*LOG(1+T).
SHOCK AND PARTICLE VELOCITIES ARE EXPRESSED IN MACH UNITS, RELATIVE TO THE AMBIENT SOUND SPEED C ABOVE.
PRESSURE IS PEAK OVERPRESSURE RATIO (PMAX-P)/P, AND PEAK OVERPRESSURE (PMAX-P) IN KILOPASCALS OBSERVED,
WHERE P IS AMBIENT PRESSURE. DENSITY IS EXPRESSED AS A RATIO, RELATIVE TO THE AMBIENT DENSITY D.

SCALED TIME= OBSERVED TIME MULTIPLIED BY (C/CO)/S, WHERE CO= 340.292 METERS/SECOND
AND SCALED DISTANCE= OBSERVED DISTANCE DIVIDED BY S= CUBE ROOT OF (W/WO)*(PO/P),
WHERE PO= 101.325 KILOPASCALS. (W, WO, AND P ARE DEFINED ABOVE.)
SCALED EVENT= STANDARD CHARGE WO IN ATMOSPHERE WHERE CO AND PO ARE AMBIENT (TO= 15 DEGREES CELSIUS).
VELOCITY, PRESSURE, AND DENSITY, EXPRESSED AS RATIOS, ARE INVARIANT UNDER SCALING.

Table 5.4

SHOCK FRONT DATA   DIPOLE WEST/9   WF5/295   SMOKE PUFF GRID 1209   R5 /A770404

MACH STEM ABOVE INTERACTION PLANE

AMBIENT TEMPERATURE T= 14.17 DEGREES CELSIUS
AMBIENT PRESSURE P= 93.02 KILOPASCALS
RELATIVE HUMIDITY RH= 55.0 PER CENT
VAPOUR PRESSURE VP= 0.89 KILOPASCALS
AMBIENT SPEED OF SOUND C= 340.469 METERS/SECOND
CHARGE WEIGHT W= 489.9 KILOGRAMS
CHARGE HEIGHT H= 4.63 METERS
SEPARATION *2 HS= 4.61 METERS
SACHS SCALING FACTOR S= 8.1111
SCALING TO CHARGE WEIGHT WO= 1.0 KILOGRAMS

SHOCK FRONT DATA COMPUTED FROM PARTICLE TRAJECTORY TIMES OF ARRIVAL

T-OBS MSEC	R-OBS METERS	R-FIT METERS	DIFFERENCE METERS	T-SCAL MSEC	R-SCAL METERS	SHOCK VELOCITY	PRESSURE RATIO	PRESSURE KPA	PARTICLE VELOCITY	DENSITY RATIO	PUFF NUMBER
3.964	7.406	7.378	-0.028	0.489	0.910	4.035	17.828	1658.268	3.156	4.590	6
6.309	10.341	10.163	-0.178	0.778	1.253	3.069	9.820	913.456	2.286	3.919	18
9.819	13.449	13.380	-0.068	1.211	1.650	2.405	5.582	519.240	1.658	3.218	29
10.695	13.959	14.081	0.123	1.319	1.736	2.302	5.014	466.361	1.556	3.087	30
13.029	15.661	15.820	0.159	1.607	1.950	2.089	3.924	365.036	1.342	2.796	42
13.903	15.905	16.431	0.526	1.715	2.026	2.026	3.624	337.118	1.277	2.736	41
14.194	16.108	16.631	0.523	1.751	2.050	2.007	3.534	328.701	1.258	2.677	40
15.358	17.577	17.412	-0.164	1.894	2.147	1.937	3.211	298.720	1.184	2.572	54
15.358	17.685	17.412	-0.272	1.894	2.147	1.937	3.211	298.720	1.184	2.572	53
15.940	17.947	17.793	-0.155	1.966	2.194	1.906	3.071	285.629	1.151	2.525	52
16.812	18.313	18.352	0.039	2.074	2.263	1.863	2.881	267.956	1.105	2.458	51
18.845	19.723	19.609	-0.114	2.325	2.418	1.777	2.516	233.997	1.011	2.322	66
19.425	20.029	19.958	-0.071	2.396	2.461	1.755	2.427	225.794	0.988	2.287	65
19.425	19.946	19.958	0.012	2.396	2.461	1.755	2.427	225.794	0.988	2.287	64
19.715	20.351	20.131	-0.221	2.432	2.482	1.745	2.386	221.901	0.977	2.271	63
21.454	21.005	21.146	0.141	2.646	2.607	1.689	2.162	201.071	0.914	2.180	62
22.612	21.798	21.805	0.007	2.789	2.688	1.656	2.034	189.215	0.877	2.126	78
22.901	21.965	21.968	0.003	2.825	2.708	1.649	2.005	186.466	0.868	2.113	77
23.480	22.253	22.291	0.038	2.896	2.748	1.634	1.948	181.199	0.852	2.089	76
23.480	22.516	22.291	-0.225	2.896	2.748	1.634	1.948	181.199	0.852	2.089	75
24.058	22.817	22.611	-0.205	2.968	2.788	1.620	1.895	176.223	0.835	2.065	74
25.214	23.254	23.243	-0.011	3.110	2.866	1.594	1.796	167.049	0.805	2.021	73
26.657	24.244	24.018	-0.226	3.288	2.961	1.564	1.686	156.851	0.770	1.971	90
26.657	24.038	24.018	-0.020	3.288	2.961	1.564	1.686	156.851	0.770	1.971	89
27.234	24.347	24.324	-0.023	3.359	2.999	1.553	1.646	153.115	0.757	1.952	88
27.522	24.507	24.476	-0.031	3.395	3.018	1.547	1.627	151.314	0.751	1.943	87
28.675	24.850	25.079	0.229	3.537	3.092	1.527	1.554	144.520	0.727	1.908	86
28.963	25.379	25.228	-0.151	3.573	3.110	1.522	1.536	142.917	0.721	1.900	101
28.963	25.518	25.228	-0.289	3.573	3.110	1.522	1.536	142.917	0.721	1.900	100
29.538	25.524	25.526	0.001	3.644	3.147	1.513	1.503	139.818	0.710	1.884	102
29.538	25.387	25.526	0.139	3.644	3.147	1.513	1.503	139.818	0.710	1.884	85
30.689	26.058	26.115	0.057	3.786	3.220	1.495	1.441	134.014	0.688	1.853	99
31.839	26.440	26.696	0.256	3.927	3.291	1.478	1.383	128.683	0.668	1.825	98
32.414	26.785	26.985	0.200	3.998	3.327	1.471	1.356	126.177	0.659	1.812	97

T IS TIME-OF-ARRIVAL AND R IS RADIAL PUFF POSITION. RADIUS VALUES ARE FITTED USING RFIT=A+B*T+C*LOG(1+T).
SHOCK AND PARTICLE VELOCITIES ARE EXPRESSED IN MACH UNITS, RELATIVE TO THE AMBIENT SOUND SPEED C ABOVE.
PRESSURE IS PEAK OVERPRESSURE RATIO (PMAX-P)/P, AND PEAK OVERPRESSURE (PMAX-P) IN KILOPASCALS OBSERVED,
WHERE P IS AMBIENT PRESSURE. DENSITY IS EXPRESSED AS A RATIO, RELATIVE TO THE AMBIENT DENSITY D.

SCALED TIME= OBSERVED TIME MULTIPLIED BY (C/CO)/S, WHERE CO= 340.292 METERS/SECOND
AND SCALED DISTANCE= OBSERVED DISTANCE DIVIDED BY S= CUBE ROOT OF (W/WO)*(PO/P),
WHERE PO= 101.325 KILOPASCALS. (W, WO, AND P ARE DEFINED ABOVE.)
SCALED EVENT= STANDARD CHARGE WO IN ATMOSPHERE WHERE CO AND PO ARE AMBIENT (TO= 15 DEGREES CELSIUS).
VELOCITY, PRESSURE, AND DENSITY, EXPRESSED AS RATIOS, ARE INVARIANT UNDER SCALING.

Table 5.5

SHOCK FRONT DATA   DIPOLE WEST/9   WF5/295   SMOKE PUFF GRID 1209   R3 /A770404

MACH STEM AT GROUND SURFACE

AMBIENT TEMPERATURE T= 14.17 DEGREES CELSIUS
AMBIENT PRESSURE P= 93.02 KILOPASCALS
RELATIVE HUMIDITY RH= 55.0 PER CENT
VAPOUR PRESSURE VP= 0.89 KILOPASCALS
AMBIENT SPEED OF SOUND C= 340.469 METERS/SECOND
CHARGE WEIGHT W= 489.9 KILOGRAMS
CHARGE HEIGHT H= 4.63 METERS
SEPARATION +2 HS= 4.61 METERS
SACHS SCALING FACTOR S= 8.1111
SCALING TO CHARGE WEIGHT WO= 1.0 KILOGRAMS

SHOCK FRONT DATA COMPUTED FROM PARTICLE TRAJECTORY TIMES OF ARRIVAL

T-OBS MSEC	R-OBS METERS	R-FIT METERS	DIFFERENCE METERS	T-SCAL MSEC	R-SCAL METERS	SHOCK VELOCITY	PRESSURE RATIO	PRESSURE KPA	PARTICLE VELOCITY	DENSITY RATIO	PUFF NUMBER
8.065	11.459	11.442	-0.016	0.995	1.411	2.947	8.963	833.694	2.173	3.807	24
10.403	13.743	13.609	-0.134	1.283	1.678	2.532	6.311	587.068	1.781	3.371	35
11.862	14.427	14.819	0.392	1.463	1.827	2.349	5.272	490.409	1.603	3.148	36
13.029	15.795	15.727	-0.068	1.607	1.939	2.231	4.639	431.486	1.485	2.993	48
13.029	15.772	15.727	-0.045	1.607	1.939	2.231	4.639	431.486	1.485	2.993	47
13.611	16.103	16.164	0.061	1.679	1.993	2.179	4.371	406.534	1.433	2.922	46
15.356	17.630	17.418	-0.212	1.894	2.147	2.045	3.710	345.101	1.296	2.732	60
15.649	17.557	17.619	0.063	1.930	2.172	2.025	3.617	336.448	1.276	2.703	59
16.231	18.084	18.016	-0.068	2.002	2.221	1.988	3.443	320.255	1.237	2.648	56
18.845	19.697	19.719	0.022	2.325	2.431	1.848	2.816	261.891	1.089	2.434	71
19.135	19.872	19.901	0.029	2.360	2.454	1.834	2.758	256.570	1.074	2.413	72
19.135	20.142	19.901	-0.241	2.360	2.454	1.834	2.758	256.570	1.074	2.413	70
22.612	21.901	21.988	0.086	2.789	2.711	1.700	2.205	205.121	0.927	2.198	83
22.612	22.215	21.988	-0.228	2.789	2.711	1.700	2.205	205.121	0.927	2.198	62
23.480	22.080	22.485	0.406	2.896	2.772	1.673	2.097	195.042	0.896	2.153	84
26.657	24.006	24.245	0.239	3.288	2.989	1.586	1.770	164.600	0.797	2.009	96
26.657	24.365	24.245	-0.120	3.288	2.989	1.586	1.770	164.600	0.797	2.009	94
26.657	24.136	24.245	0.109	3.288	2.989	1.586	1.770	164.600	0.797	2.009	95
28.903	25.604	25.470	-0.134	3.573	3.140	1.535	1.584	147.309	0.737	1.922	107
28.903	25.771	25.470	-0.301	3.573	3.140	1.535	1.584	147.309	0.737	1.922	106
29.538	25.610	25.769	0.160	3.644	3.177	1.524	1.542	143.477	0.723	1.903	108

T IS TIME-OF-ARRIVAL AND R IS RADIAL PUFF POSITION. RADIUS VALUES ARE FITTED USING RFIT=A+B*T+C*LOG(1+T).
SHOCK AND PARTICLE VELOCITIES ARE EXPRESSED IN MACH UNITS, RELATIVE TO THE AMBIENT SOUND SPEED C ABOVE.
PRESSURE IS PEAK OVERPRESSURE RATIO (PMAX-P)/P, AND PEAK OVERPRESSURE (PMAX-P) IN KILOPASCALS OBSERVED,
WHERE P IS AMBIENT PRESSURE. DENSITY IS EXPRESSED AS A RATIO, RELATIVE TO THE AMBIENT DENSITY D.

SCALED TIME= OBSERVED TIME MULTIPLIED BY (C/CO)/S, WHERE CO= 340.292 METERS/SECOND
AND SCALED DISTANCE= OBSERVED DISTANCE DIVIDED BY S= CUBE ROOT OF (W/WO)*(PO/P),
WHERE PO= 101.325 KILOPASCALS. (W, WO, AND P ARE DEFINED ABOVE.)
SCALED EVENT= STANDARD CHARGE WO IN ATMOSPHERE WHERE CO AND PO ARE AMBIENT (TO= 15 DEGREES CELSIUS).
VELOCITY, PRESSURE, AND DENSITY, EXPRESSED AS RATIOS, ARE INVARIANT UNDER SCALING.

Table 7.1

VELOCITY FIELD   DIPOLE WEST/9   WFS/295   SMOKE PUFF GRID 1209   /A770404

PARTICLE VELOCITIES AT SCALED TIME= 1.000 MS

X-SCAL METERS	Y-SCAL METERS	U=DX/DT MACH NO	V=DY/DT MACH NO	PARTICLE VELOCITY	R-SCAL METERS	REGN CODE
1.167	2.256	0.91	0.42	1.005	1.289	2
1.270	1.787	1.08	0.06	1.087	1.273	2
1.246	1.568	1.35	0.19	1.359	1.254	2
1.269	1.356	1.35	-0.12	1.352	1.287	5
1.221	1.073	1.36	0.03	1.364	1.223	4
1.208	0.895	1.41	-0.07	1.414	1.291	4
1.271	0.685	1.31	-0.07	1.309	1.276	1
1.283	0.239	1.53	0.07	1.529	1.326	1
1.359	2.162	1.15	0.36	1.201	1.433	2
1.386	1.998	1.35	0.28	1.377	1.416	2

X-SCAL METERS	Y-SCAL METERS	U=DX/DT MACH NO	V=DY/DT MACH NO	PARTICLE VELOCITY	R-SCAL METERS	REGN CODE
1.409	1.783	1.36	0.01	1.364	1.411	2
1.406	1.574	1.39	-0.00	1.394	1.412	2
1.379	1.404	1.45	-0.03	1.453	1.405	5
1.411	1.230	1.80	0.28	1.825	1.413	5
1.435	1.012	2.08	-0.33	2.102	1.440	4
1.396	0.843	1.43	-0.05	1.434	1.427	4
1.394	0.674	1.29	-0.04	1.292	1.398	1
1.386	0.457	1.32	-0.09	1.327	1.391	1
1.379	0.271	1.45	-0.38	1.499	1.412	1
1.409	0.131	1.64	-0.18	1.653	1.416	3

PARTICLE VELOCITIES AT SCALED TIME= 2.000 MS

X-SCAL METERS	Y-SCAL METERS	U=DX/DT MACH NO	V=DY/DT MACH NO	PARTICLE VELOCITY	R-SCAL METERS	REGN CODE
1.618	2.250	0.59	0.23	0.633	1.706	2
1.666	2.083	0.64	0.31	0.711	1.707	2
1.715	1.851	0.56	0.17	0.581	1.721	2
1.725	1.607	0.49	0.06	0.493	1.728	2
1.669	1.390	0.46	-0.02	0.457	1.698	5
1.744	0.859	0.69	0.16	0.706	1.767	4
1.767	0.668	0.77	0.06	0.768	1.848	4
1.765	0.455	0.73	-0.05	0.729	1.768	1
1.754	0.251	0.76	-0.26	0.804	1.772	3
1.639	2.238	0.74	0.26	0.785	1.914	2
1.883	2.032	0.80	0.26	0.840	1.911	2
1.902	1.818	0.83	0.30	0.883	1.906	2
1.963	1.470	0.86	0.28	0.903	1.991	5
1.960	1.254	0.83	0.07	0.831	1.983	5
1.998	0.987	0.90	-0.06	0.904	2.004	4
1.974	0.789	0.98	-0.08	0.985	2.005	4
1.919	0.658	0.89	0.10	0.891	1.979	4
1.938	0.474	0.95	-0.03	0.949	1.996	3
1.970	0.349	1.02	0.05	1.017	2.001	3
1.983	0.136	1.01	0.02	1.005	1.988	3

X-SCAL METERS	Y-SCAL METERS	U=DX/DT MACH NO	V=DY/DT MACH NO	PARTICLE VELOCITY	R-SCAL METERS	REGN CODE
1.978	2.157	0.67	0.20	0.704	2.028	2
2.010	1.982	0.94	0.27	0.976	2.029	2
2.014	1.790	0.79	0.23	0.827	2.016	2
2.058	1.629	1.27	0.40	1.329	2.116	5
2.103	1.448	1.35	0.25	1.372	2.125	5
2.106	1.242	1.10	0.04	1.101	2.108	5
2.100	1.032	1.00	-0.07	1.001	2.103	4
2.086	0.834	1.05	-0.09	1.053	2.108	4
2.068	0.646	1.06	-0.21	1.079	2.126	4
2.071	0.497	1.21	0.06	1.207	2.130	3
2.081	0.328	1.07	0.06	1.075	2.106	3
2.092	0.128	1.02	0.02	1.015	2.095	3
2.178	1.608	1.25	0.50	1.342	2.228	5
2.204	1.413	1.09	0.01	1.085	2.221	5
2.208	1.228	1.15	-0.08	1.150	2.209	5
2.207	1.063	1.10	-0.11	1.109	2.208	4
2.196	0.858	1.12	-0.23	1.145	2.214	4
2.181	0.664	1.04	-0.19	1.056	2.232	4
2.173	0.277	1.05	0.21	1.073	2.190	3
2.196	0.114	0.99	0.06	0.994	2.199	3

OBSERVED DISTANCE VALUES= 8.1111 TIMES SCALED VALUES
AND OBSERVED TIME VALUE = 8.1069 TIMES SCALED VALUE.
VELOCITY VALUES AS SHOWN ARE INVARIANT UNDER SCALING.

Table 7.2

VELOCITY FIELD   DIPOLE WEST/9   WF5/295   SMOKE PUFF GRID 1209   /A770404

PARTICLE VELOCITIES AT SCALED TIME= 3.000 MS

X-SCAL METERS	Y-SCAL METERS	U=DX/DT MACH NO	V=DY/DT MACH NO	PARTICLE VELOCITY	R-SCAL METERS	REGN CODE
1.712	2.314	0.16	0.13	0.203	1.817	2
1.787	2.145	0.19	0.10	0.218	1.840	2
1.828	1.894	0.21	0.06	0.223	1.836	2
1.826	1.620	0.26	0.09	0.274	1.888	5
1.780	1.413	0.24	0.11	0.264	1.800	5
1.899	0.925	0.28	0.16	0.320	1.911	4
1.926	0.702	0.21	0.10	0.232	1.975	4
1.910	0.444	0.27	0.06	0.273	1.961	3
1.930	0.222	0.34	0.08	0.345	1.942	3
2.009	2.304	0.35	0.13	0.368	2.096	2
2.087	2.120	0.40	0.17	0.434	2.127	2
2.064	1.873	0.21	0.02	0.211	2.071	2
2.162	1.534	0.37	0.12	0.391	2.197	5
2.185	1.290	0.44	0.13	0.458	2.190	5
2.231	1.002	0.51	0.10	0.519	2.236	4
2.209	0.786	0.43	0.02	0.435	2.237	4
2.100	0.691	0.25	0.08	0.262	2.147	4
2.143	0.457	0.31	-0.02	0.311	2.191	3
2.216	0.357	0.47	0.07	0.478	2.244	3
2.252	0.137	0.59	0.01	0.587	2.256	3
2.207	2.242	0.49	0.25	0.551	2.270	2
2.257	2.076	0.58	0.18	0.603	2.287	2
2.242	1.858	0.55	0.17	0.574	2.355	5
2.324	1.713	0.47	0.15	0.495	2.394	5
2.377	1.493	0.53	0.11	0.542	2.403	5
2.368	1.268	0.55	0.08	0.558	2.371	5
2.364	1.036	0.55	0.05	0.554	2.366	4
2.361	0.837	0.56	0.04	0.560	2.381	4
2.342	0.617	0.54	-0.03	0.541	2.399	4
2.369	0.496	0.60	-0.00	0.599	2.420	3
2.365	0.315	0.63	-0.00	0.632	2.386	3
2.375	0.120	0.67	0.00	0.668	2.378	3
2.348	2.232	0.63	0.29	0.690	2.406	2

X-SCAL METERS	Y-SCAL METERS	U=DX/DT MACH NO	V=DY/DT MACH NO	PARTICLE VELOCITY	R-SCAL METERS	REGN CODE
2.389	2.056	0.61	0.25	0.658	2.414	2
2.442	1.883	0.63	0.15	0.652	2.553	5
2.466	1.684	0.57	0.10	0.575	2.525	5
2.469	1.430	0.56	0.10	0.567	2.486	5
2.502	1.219	0.64	0.05	0.639	2.503	5
2.508	1.066	0.66	0.08	0.669	2.509	4
2.508	0.847	0.68	0.05	0.677	2.525	4
2.487	0.623	0.71	-0.07	0.708	2.540	4
2.518	0.451	0.82	-0.05	0.825	2.558	3
2.473	0.284	0.71	-0.02	0.710	2.490	3
2.505	2.198	0.69	0.32	0.762	2.553	2
2.563	2.006	0.79	0.28	0.840	2.705	5
2.585	1.836	0.73	0.25	0.771	2.677	5
2.614	1.626	0.74	0.14	0.750	2.659	5
2.622	1.452	0.68	0.07	0.688	2.640	5
2.612	1.234	0.66	0.12	0.671	2.614	5
2.627	1.031	0.77	0.07	0.772	2.629	4
2.633	0.835	0.74	-0.00	0.744	2.650	4
2.632	0.676	0.82	0.04	0.817	2.672	4
2.665	0.430	0.89	-0.06	0.889	2.699	3
2.614	0.272	0.80	-0.03	0.801	2.628	3
2.626	0.102	0.83	-0.03	0.833	2.628	3
2.693	1.981	0.71	0.30	0.773	2.821	5
2.728	1.800	0.84	0.16	0.855	2.807	5
2.732	1.598	0.71	0.25	0.747	2.770	5
2.751	1.420	0.89	0.04	0.894	2.765	5
2.757	1.222	0.92	-0.03	0.922	2.759	5
2.758	1.034	0.79	0.02	0.795	2.760	4
2.751	0.848	0.90	0.03	0.897	2.766	4
2.768	0.670	1.01	0.02	1.007	2.807	4
2.768	0.493	0.98	-0.06	0.978	2.811	3
2.753	0.271	0.92	-0.22	0.948	2.766	3
2.750	0.101	0.85	-0.17	0.870	2.752	3

OBSERVED DISTANCE VALUES= 8.1111 TIMES SCALED VALUES
AND OBSERVED TIME VALUE = 8.1069 TIMES SCALED VALUE.
VELOCITY VALUES AS SHOWN ARE INVARIANT UNDER SCALING.

Table 7.3

VELOCITY FIELD   DIPOLE WEST/9   WF5/295   SMOKE PUFF GRID 1209   /A770404

PARTICLE VELOCITIES AT SCALED TIME= 4.000 MS

X-SCAL METERS	Y-SCAL METERS	U=DX/DT MACH NO	V=DY/DT MACH NO	PARTICLE VELOCITY	R-SCAL METERS	REGN CODE
1.878	2.181	0.46	0.16	0.486	1.937	2
1.935	1.917	0.53	0.17	0.554	1.947	2
1.930	1.054	0.19	-0.09	0.212	1.998	5
1.804	1.439	0.30	0.06	0.303	1.888	5
1.997	0.965	0.46	0.18	0.490	2.004	4
2.006	0.738	0.21	0.21	0.296	2.046	4
1.997	0.485	0.15	-0.03	0.149	2.055	3
2.005	0.233	0.18	0.05	0.186	2.019	3
2.170	2.126	0.15	-0.02	0.155	2.216	2
2.145	1.883	0.36	0.11	0.377	2.152	2
2.254	1.579	0.24	0.16	0.287	2.297	5
2.298	1.334	0.26	0.10	0.283	2.306	5
2.342	1.023	0.16	0.01	0.164	2.344	4
2.309	0.790	0.22	0.03	0.220	2.335	4
2.171	0.730	0.26	0.17	0.308	2.209	4
2.218	0.489	0.21	0.19	0.282	2.271	3
2.331	0.408	0.25	0.20	0.317	2.367	3
2.387	0.159	0.23	0.11	0.255	2.393	3
2.303	2.298	0.17	0.06	0.178	2.378	2
2.374	2.118	0.21	0.08	0.221	2.409	2
2.368	1.904	0.30	0.10	0.321	2.507	5
2.446	1.755	0.30	0.12	0.322	2.524	5
2.529	1.540	0.36	0.14	0.384	2.560	5
2.514	1.301	0.32	0.11	0.342	2.519	5
2.494	1.053	0.26	0.04	0.260	2.495	4
2.489	0.850	0.25	0.04	0.256	2.506	4
2.459	0.617	0.21	0.04	0.213	2.514	4
2.514	0.514	0.30	0.11	0.318	2.566	3
2.527	0.348	0.34	0.16	0.377	2.551	3
2.551	0.143	0.37	0.11	0.383	2.555	3
2.492	2.295	0.23	0.09	0.247	2.560	2
2.531	2.115	0.26	0.11	0.281	2.713	5
2.591	1.921	0.29	0.11	0.313	2.707	5
2.615	1.722	0.35	0.14	0.375	2.679	5
2.617	1.472	0.33	0.13	0.356	2.638	5
2.665	1.253	0.35	0.12	0.366	2.657	5
2.672	1.096	0.34	0.08	0.345	2.673	4
2.607	0.858	0.31	0.02	0.308	2.682	4
2.601	0.615	0.35	0.02	0.354	2.712	4
2.746	0.448	0.53	0.02	0.532	2.783	3
2.659	0.302	0.40	0.13	0.419	2.676	3
2.686	2.298	0.39	0.21	0.441	2.748	2
2.745	2.080	0.34	0.16	0.378	2.902	5
2.773	1.902	0.39	0.14	0.415	2.676	5
2.792	1.666	0.37	0.12	0.389	2.841	5

X-SCAL METERS	Y-SCAL METERS	U=DX/DT MACH NO	V=DY/DT MACH NO	PARTICLE VELOCITY	R-SCAL METERS	REGN CODE
2.800	1.472	0.39	0.07	0.400	2.819	5
2.784	1.265	0.37	0.07	0.378	2.787	5
2.821	1.059	0.38	0.06	0.385	2.822	4
2.812	0.847	0.35	0.04	0.348	2.828	4
2.861	0.696	0.52	0.07	0.530	2.895	4
2.906	0.424	0.55	0.02	0.553	2.937	3
2.832	0.281	0.48	0.07	0.482	2.846	3
2.866	0.099	0.53	0.02	0.533	2.867	3
2.868	2.249	0.49	0.22	0.531	3.075	5
2.907	2.057	0.49	0.16	0.511	3.049	5
2.936	1.845	0.43	0.13	0.447	3.020	5
2.936	1.638	0.47	0.08	0.481	2.978	5
2.965	1.442	0.45	0.10	0.461	2.980	5
2.986	1.251	0.48	0.12	0.498	2.988	5
2.978	1.058	0.49	0.06	0.490	2.980	4
2.979	0.854	0.48	0.01	0.479	2.993	4
3.023	0.677	0.56	0.04	0.563	3.058	4
3.026	0.482	0.59	0.00	0.586	3.064	3
3.015	0.237	0.62	-0.02	0.618	3.024	3
3.002	0.083	0.60	0.02	0.597	3.003	3
3.037	2.179	0.55	0.20	0.590	3.210	5
3.038	2.026	0.53	0.17	0.557	3.165	5
3.082	1.817	0.51	0.10	0.518	3.156	5
3.110	1.597	0.51	0.10	0.522	3.144	5
3.112	1.410	0.53	0.10	0.543	3.124	5
3.147	1.206	0.60	0.10	0.607	3.148	5
3.126	1.045	0.59	0.08	0.590	3.127	4
3.149	0.878	0.61	0.08	0.616	3.159	4
3.157	0.662	0.61	0.02	0.613	3.193	4
3.159	0.447	0.65	-0.00	0.647	3.190	3
3.151	0.248	0.70	-0.02	0.696	3.161	3
3.148	0.076	0.72	0.02	0.723	3.149	3
3.148	2.138	0.71	0.19	0.732	3.303	5
3.170	1.974	0.70	0.22	0.733	3.279	5
3.193	1.775	0.55	0.05	0.553	3.256	5
3.201	1.581	0.55	0.09	0.558	3.231	5
3.199	1.409	0.55	0.08	0.558	3.210	5
3.227	1.203	0.63	0.07	0.630	3.228	5
3.247	1.050	0.69	0.11	0.699	3.249	4
3.241	0.865	0.70	0.09	0.710	3.253	4
3.251	0.654	0.68	-0.02	0.681	3.287	4
3.254	0.476	0.72	-0.04	0.717	3.288	3
3.252	0.262	0.73	-0.07	0.733	3.263	3
3.248	0.098	0.76	-0.07	0.766	3.249	3

OBSERVED DISTANCE VALUES= 8.1111 TIMES SCALED VALUES
AND OBSERVED TIME VALUE = 8.1069 TIMES SCALED VALUE.
VELOCITY VALUES AS SHOWN ARE INVARIANT UNDER SCALING.

Table 7.4

VELOCITY FIELD DIPOLE WEST/9 WF5/295 SMOKE PUFF GRID 1209 /A770404

PARTICLE VELOCITIES AT SCALED TIME= 5.000 MS

X-SCAL METERS	Y-SCAL METERS	U=DX/DT MACH NO	V=DY/DT MACH NO	PARTICLE VELOCITY	R-SCAL METERS	REGN CODE
2.435	2.143	0.15	0.07	0.167	2.473	2
2.450	1.927	0.06	0.04	0.070	2.573	5
2.537	1.800	0.23	0.13	0.264	2.621	5
2.620	1.577	0.26	0.07	0.273	2.657	5
2.570	1.063	0.23	0.03	0.228	2.571	4
2.570	0.873	0.25	0.10	0.264	2.583	4
2.524	0.649	0.20	0.12	0.237	2.571	4
2.595	0.557	0.20	0.11	0.222	2.650	4
2.609	0.390	0.17	0.05	0.173	2.638	3
2.633	0.169	0.14	0.03	0.145	2.638	3
2.547	2.314	0.15	0.05	0.154	2.618	2
2.593	2.145	0.15	0.09	0.174	2.781	5
2.673	1.966	0.23	0.14	0.266	2.798	5
2.713	1.772	0.24	0.12	0.269	2.786	5
2.704	1.508	0.20	0.08	0.213	2.729	5
2.750	1.282	0.18	0.03	0.184	2.754	5
2.762	1.116	0.23	0.05	0.235	2.763	4
2.753	0.876	0.24	0.10	0.261	2.766	4
2.759	0.632	0.27	0.08	0.277	2.806	4
2.891	0.461	0.33	0.04	0.335	2.927	3
2.756	0.349	0.21	0.10	0.229	2.780	3
2.782	2.338	0.19	0.08	0.207	3.029	5
2.831	2.127	0.20	0.12	0.239	2.998	5
2.871	1.944	0.23	0.12	0.254	2.981	5
2.891	1.711	0.24	0.13	0.269	2.947	5
2.904	1.499	0.24	0.08	0.249	2.927	5
2.880	1.236	0.21	0.06	0.219	2.884	5
2.911	1.071	0.19	0.03	0.197	2.911	4
2.697	0.861	0.19	0.05	0.199	2.910	4
2.998	0.726	0.30	0.11	0.321	3.026	4
3.053	0.437	0.32	0.05	0.328	3.084	3
2.948	0.311	0.23	0.09	0.248	2.964	3
2.990	0.112	0.23	0.05	0.232	2.992	3
2.977	2.293	0.20	0.08	0.211	3.193	5
3.023	2.101	0.23	0.12	0.262	3.173	5

OBSERVED DISTANCE VALUES= 8.1111 TIMES SCALED VALUES
AND OBSERVED TIME VALUE = 8.1069 TIMES SCALED VALUE.
VELOCITY VALUES AS SHOWN ARE INVARIANT UNDER SCALING.

X-SCAL METERS	Y-SCAL METERS	U=DX/DT MACH NO	V=DY/DT MACH NO	PARTICLE VELOCITY	R-SCAL METERS	REGN CODE
3.047	1.891	0.25	0.14	0.287	3.138	5
3.057	1.675	0.26	0.13	0.287	3.103	5
3.086	1.480	0.28	0.10	0.294	3.105	5
3.111	1.284	0.28	0.07	0.284	3.115	5
3.097	1.071	0.24	0.03	0.242	3.097	4
3.101	0.865	0.27	0.06	0.274	3.113	4
3.176	0.702	0.35	0.10	0.366	3.206	4
3.186	0.497	0.37	0.07	0.375	3.224	3
3.179	0.243	0.36	0.04	0.357	3.188	3
3.155	0.094	0.32	0.03	0.318	3.156	3
3.177	2.235	0.30	0.13	0.327	3.360	5
3.174	2.072	0.30	0.11	0.321	3.309	5
3.217	1.853	0.32	0.12	0.339	3.296	5
3.255	1.638	0.36	0.13	0.380	3.293	5
3.259	1.450	0.34	0.11	0.358	3.274	5
3.304	1.238	0.32	0.06	0.325	3.305	5
3.275	1.063	0.32	0.03	0.321	3.276	4
3.312	0.901	0.38	0.05	0.386	3.321	4
3.324	0.676	0.41	0.06	0.411	3.356	4
3.338	0.459	0.42	0.06	0.428	3.369	3
3.344	0.253	0.44	0.02	0.440	3.353	3
3.339	0.067	0.41	0.04	0.408	3.340	3
3.320	2.196	0.35	0.13	0.368	3.484	5
3.334	2.019	0.35	0.12	0.364	3.449	5
3.338	1.806	0.35	0.12	0.367	3.404	5
3.359	1.616	0.37	0.12	0.393	3.393	5
3.363	1.449	0.39	0.11	0.407	3.377	5
3.398	1.235	0.38	0.08	0.392	3.400	5
3.443	1.083	0.43	0.07	0.433	3.443	4
3.425	0.886	0.41	0.05	0.411	3.435	4
3.434	0.659	0.44	0.06	0.445	3.468	4
3.452	0.476	0.46	0.05	0.466	3.485	3
3.462	0.265	0.49	0.03	0.487	3.472	3
3.468	0.089	0.50	0.01	0.497	3.469	3

Table 7.5

VELOCITY FIELD   DIPOLE WEST/9   WF5/295   SMOKE PUFF GRID 1209   /A770404

PARTICLE VELOCITIES AT SCALED TIME= 6.000 MS

X-SCAL METERS	Y-SCAL METERS	U=DX/DT MACH NO	V=DY/DT MACH NO	PARTICLE VELOCITY	R-SCAL METERS	REGN CODE
2.661	2.186	0.27	0.16	0.316	2.859	5
2.758	2.008	0.26	0.11	0.279	2.891	5
2.789	1.803	0.24	0.09	0.261	2.867	5
2.773	1.527	0.26	0.06	0.266	2.830	5
2.816	1.292	0.27	0.10	0.285	2.820	5
2.843	1.140	0.25	0.10	0.270	2.843	5
2.834	0.907	0.18	0.00	0.180	2.844	4
2.845	0.650	0.19	-0.01	0.188	2.887	4
2.983	0.469	0.23	-0.00	0.228	3.020	3
2.814	0.362	0.13	0.01	0.135	2.837	3
2.902	2.173	0.22	0.15	0.265	3.081	5
2.945	1.987	0.22	0.13	0.259	3.065	5
2.901	1.743	0.18	0.05	0.190	3.022	5
2.970	1.518	0.17	0.03	0.169	2.994	5
2.943	1.306	0.18	0.07	0.193	2.948	5
2.979	1.094	0.22	0.10	0.241	2.979	4
2.961	0.884	0.19	0.07	0.203	2.972	4
3.083	0.767	0.21	0.12	0.248	3.106	4
3.137	0.450	0.19	0.02	0.188	3.170	3
3.005	0.336	0.12	0.05	0.134	3.024	3
3.045	0.124	0.13	0.02	0.136	3.048	3
3.037	2.323	0.19	0.11	0.225	3.260	5
3.097	2.144	0.23	0.13	0.267	3.256	5
3.119	1.940	0.19	0.14	0.239	3.220	5
3.128	1.710	0.19	0.06	0.202	3.190	5
3.158	1.504	0.16	0.04	0.169	3.179	5
3.185	1.304	0.18	0.07	0.191	3.189	5
3.166	1.093	0.20	0.10	0.222	3.166	4

X-SCAL METERS	Y-SCAL METERS	U=DX/DT MACH NO	V=DY/DT MACH NO	PARTICLE VELOCITY	R-SCAL METERS	REGN CODE
3.178	0.896	0.20	0.10	0.224	3.187	4
3.269	0.739	0.21	0.10	0.232	3.294	4
3.284	0.522	0.22	0.06	0.225	3.325	3
3.269	0.256	0.19	0.04	0.196	3.279	3
3.233	0.103	0.16	0.02	0.166	3.235	3
3.259	2.273	0.20	0.11	0.231	3.451	5
3.258	2.112	0.21	0.13	0.247	3.400	5
3.303	1.895	0.19	0.11	0.220	3.388	5
3.347	1.675	0.17	0.08	0.192	3.389	5
3.343	1.479	0.16	0.06	0.175	3.360	5
3.380	1.256	0.17	0.07	0.181	3.382	5
3.358	1.083	0.19	0.10	0.215	3.358	4
3.420	0.931	0.26	0.14	0.290	3.426	4
3.438	0.705	0.26	0.10	0.275	3.465	4
3.451	0.480	0.24	0.06	0.250	3.484	3
3.458	0.262	0.25	0.03	0.251	3.468	3
3.412	2.232	0.23	0.11	0.258	3.583	5
3.432	2.064	0.24	0.13	0.276	3.555	5
3.435	1.850	0.22	0.12	0.249	3.508	5
3.457	1.655	0.21	0.09	0.231	3.495	5
3.463	1.476	0.21	0.06	0.214	3.479	5
3.497	1.255	0.21	0.06	0.221	3.499	5
3.552	1.107	0.26	0.09	0.274	3.553	4
3.538	0.913	0.27	0.11	0.294	3.545	4
3.557	0.687	0.28	0.08	0.290	3.586	4
3.580	0.496	0.30	0.04	0.306	3.614	3
3.592	0.271	0.30	0.01	0.302	3.602	3
3.595	0.092	0.28	-0.00	0.284	3.596	3

OBSERVED DISTANCE VALUES= 8.1111 TIMES SCALED VALUES
AND OBSERVED TIME VALUE = 8.1069 TIMES SCALED VALUE.
VELOCITY VALUES AS SHOWN ARE INVARIANT UNDER SCALING.

Table 7.6

VELOCITY FIELD　　DIPOLE WEST/9　　WF5/295　　SMOKE PUFF GRID 1209　　/A770404

PARTICLE VELOCITIES AT SCALED TIME= 7.000 MS

X-SCAL METERS	Y-SCAL METERS	U=DX/DT MACH NO	V=DY/DT MACH NO	PARTICLE VELOCITY	R-SCAL METERS	REGN CODE
2.967	2.216	0.11	0.07	0.130	3.157	5
3.008	2.017	0.08	-0.01	0.083	3.134	5
3.025	1.767	0.22	0.16	0.273	3.090	5
3.032	1.546	0.23	0.21	0.307	3.059	5
3.038	1.114	0.04	-0.07	0.080	3.038	4
2.999	0.887	-0.05	-0.13	0.137	3.010	4
3.143	0.796	0.09	0.01	0.086	3.159	4
3.191	0.449	0.15	-0.01	0.149	3.223	3
3.037	0.351	0.05	0.06	0.076	3.057	3
3.085	0.132	0.07	0.05	0.082	3.088	3
3.165	2.181	0.08	0.04	0.086	3.332	5
3.188	1.978	0.22	0.08	0.234	3.297	5
3.198	1.736	0.22	0.17	0.274	3.253	5
3.231	1.533	0.37	0.20	0.416	3.255	5
3.258	1.335	0.31	0.11	0.326	3.264	5
3.236	1.120	0.19	-0.02	0.190	3.236	4
3.231	0.904	0.08	-0.13	0.152	3.239	4
3.336	0.757	0.24	-0.02	0.239	3.358	4
3.338	0.528	0.11	-0.03	0.109	3.379	3
3.324	0.259	0.16	-0.04	0.160	3.334	3
3.271	0.108	0.04	-0.01	0.043	3.273	3
3.329	2.312	0.24	0.09	0.256	3.529	5

X-SCAL METERS	Y-SCAL METERS	U=DX/DT MACH NO	V=DY/DT MACH NO	PARTICLE VELOCITY	R-SCAL METERS	REGN CODE
3.326	2.150	0.20	0.06	0.203	3.476	5
3.364	1.923	0.23	0.07	0.239	3.454	5
3.407	1.698	0.31	0.08	0.325	3.452	5
3.405	1.506	0.32	0.12	0.340	3.425	5
3.450	1.286	0.29	0.08	0.300	3.453	5
3.424	1.115	0.24	-0.01	0.239	3.424	4
3.490	0.969	0.16	-0.02	0.164	3.494	4
3.504	0.732	0.18	0.02	0.182	3.527	4
3.512	0.498	0.15	0.04	0.156	3.547	3
3.525	0.270	0.16	-0.02	0.157	3.535	3
3.484	2.279	0.17	0.14	0.217	3.666	5
3.502	2.103	0.18	0.12	0.214	3.632	5
3.488	1.877	0.12	0.02	0.126	3.565	5
3.515	1.677	0.14	0.09	0.169	3.556	5
3.519	1.497	0.15	0.06	0.168	3.537	5
3.557	1.287	0.16	0.13	0.202	3.560	5
3.628	1.147	0.14	0.12	0.182	3.628	5
3.614	0.946	0.16	0.02	0.165	3.619	4
3.630	0.705	0.19	0.01	0.188	3.656	4
3.665	0.504	0.20	0.07	0.209	3.700	3
3.672	0.278	0.14	0.04	0.143	3.682	3
3.677	0.086	0.18	-0.01	0.184	3.678	3

OBSERVED DISTANCE VALUES= 8.1111 TIMES SCALED VALUES
AND OBSERVED TIME VALUE = 8.1069 TIMES SCALED VALUE.
VELOCITY VALUES AS SHOWN ARE INVARIANT UNDER SCALING.

Table 8.1

DENSITY FIELD DIPOLE WEST/9 WF5/295 SMOKE PUFF GRID 1209 /A770404

AVERAGE DENSITIES AT SCALED TIME= 1.000 MS

X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE
1.332	1.076	1.796	1.333	2	1.524	1.885	1.264	1.534	2	1.517	0.570	1.311	1.517	1
1.322	1.491	1.955	1.341	2	1.534	1.316	1.416	1.544	5	1.522	0.372	1.350	1.535	1
1.331	0.963	1.791	1.343	4	1.552	1.134	1.461	1.552	5	1.563	0.202	1.253	1.576	3
1.330	0.776	2.267	1.346	1	1.531	0.931	1.660	1.545	4					
1.513	2.079	1.203	1.558	2	1.523	0.761	1.394	1.535	1					

AVERAGE DENSITIES AT SCALED TIME= 2.000 MS

X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE
1.755	2.151	1.294	1.810	2	2.018	0.415	2.466	2.060	3	2.134	0.210	2.113	2.144	3
1.790	1.949	1.314	1.806	2	2.031	0.236	1.464	2.044	3	2.302	1.687	1.045	2.366	5
1.853	0.751	1.729	1.893	4	2.081	2.068	1.419	2.113	2	2.309	1.505	1.093	2.338	5
1.850	0.559	1.887	1.850	1	2.091	1.879	1.578	2.098	2	2.327	1.318	1.157	2.334	5
1.851	0.377	1.758	1.889	3	2.104	1.704	1.797	2.179	5	2.318	1.133	1.170	2.318	4
1.926	2.104	2.016	1.966	2	2.136	1.528	2.000	2.171	5	2.312	0.953	1.157	2.319	4
1.951	1.908	2.071	1.962	2	2.154	1.333	1.938	2.163	5	2.313	0.759	1.153	2.344	4
2.037	1.355	1.326	2.049	5	2.153	1.140	2.093	2.153	5	2.318	0.568	1.078	2.387	4
2.043	1.132	1.564	2.043	4	2.148	0.946	2.157	2.156	4	2.295	0.378	1.064	2.326	3
2.039	0.909	1.960	2.052	4	2.133	0.750	2.094	2.168	4	2.309	0.196	1.070	2.318	3
2.015	0.727	1.955	2.057	4	2.125	0.575	2.608	2.199	4					
1.997	0.570	2.079	2.076	4	2.127	0.399	2.501	2.164	3					

AVERAGE DENSITIES AT SCALED TIME= 3.000 MS

X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE
1.901	2.221	0.918	1.969	2	2.430	1.146	1.361	2.430	5	2.684	1.330	1.700	2.691	5
1.940	2.011	0.778	1.964	2	2.436	0.946	1.353	2.444	4	2.688	1.132	1.663	2.688	4
2.026	0.788	1.119	2.056	4	2.425	0.731	1.207	2.459	4	2.691	0.939	1.992	2.699	4
2.018	0.568	1.049	2.098	4	2.433	0.547	1.918	2.494	3	2.697	0.756	1.983	2.724	4
2.037	0.362	1.152	2.069	3	2.432	0.391	1.730	2.463	3	2.704	0.571	1.758	2.763	4
2.136	2.188	1.443	2.191	2	2.452	2.122	1.745	2.487	2	2.703	0.361	2.073	2.727	3
2.161	1.982	1.085	2.178	2	2.494	1.948	1.855	2.622	5	2.686	0.18[illegible]	2.128	2.693	3
2.272	1.400	0.711	2.287	5	2.527	1.757	1.547	2.602	5	2.817	2.073	1.023	2.968	5
2.263	1.155	0.926	2.284	5	2.538	1.548	1.329	2.571	5	2.831	1.893	1.086	2.929	5
2.291	0.913	1.220	2.302	4	2.551	1.339	1.786	2.559	5	2.846	1.690	1.129	2.898	5
2.262	0.723	1.109	2.300	4	2.565	1.137	1.886	2.565	5	2.852	1.502	1.162	2.875	5
2.226	0.556	1.066	2.299	4	2.568	0.944	1.798	2.575	4	2.862	1.308	1.265	2.867	5
2.281	0.412	1.475	2.318	3	2.561	0.743	1.917	2.592	4	2.861	1.126	1.307	2.861	4
2.300	0.235	1.048	2.312	3	2.580	0.547	1.671	2.637	3	2.853	0.945	1.307	2.860	4
2.303	2.153	1.792	2.343	2	2.567	0.360	1.853	2.592	3	2.862	0.766	1.341	2.867	4
2.330	1.961	1.320	2.471	5	2.609	2.090	1.651	2.777	5	2.868	0.573	1.349	2.923	4
2.371	1.791	1.190	2.459	5	2.643	1.904	1.966	2.752	5	2.860	0.375	1.285	2.885	3
2.410	1.589	1.326	2.452	5	2.664	1.718	2.065	2.727	5	2.855	0.189	1.265	2.862	3
2.428	1.346	1.413	2.437	5	2.680	1.523	1.934	2.707	5					

X AND Y LOCATE THE CENTER OF A PLANE QUADRILATERAL WHICH IS A CELL OF 4 NEIGHBOURING SMOKE PUFFS.
DENSITY IS AVERAGED OVER THE AREA OF THE CELL AND IS EXPRESSED AS A RATIO TO THE AMBIENT DENSITY.

OBSERVED DISTANCE VALUES= 8.1111 TIMES SCALED VALUES
AND OBSERVED TIME VALUE = 8.1069 TIMES SCALED VALUE.
DENSITY VALUES AS SHOWN ARE INVARIANT UNDER SCALING.

Table 8.2

DENSITY FIELD   DIPOLE WEST/9   WFS/295   SMOKE PUFF GRID 1209   /A770404

AVERAGE DENSITIES AT SCALED TIME= 4.000 MS

X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE
2.031	2.034	0.803	2.057	2	2.616	2.193	1.204	2.821	5	2.991	1.934	1.672	3.095	5
2.112	0.820	1.116	2.136	4	2.659	2.007	1.237	2.797	5	3.017	1.721	1.483	3.072	5
2.098	0.605	1.064	2.165	4	2.695	1.803	1.082	2.776	5	3.030	1.525	1.428	3.055	5
2.124	0.391	0.965	2.160	3	2.702	1.583	1.002	2.738	5	3.053	1.326	1.70[illegible]	3.059	5
2.207	2.004	0.830	2.286	2	2.715	1.373	1.484	2.725	5	3.057	1.142	1.662	3.057	5
2.399	1.443	0.532	2.418	5	2.739	1.165	1.486	2.739	5	3.056	0.956	1.473	3.061	4
2.406	1.185	0.703	2.409	5	2.742	0.966	1.282	2.747	4	3.079	0.772	1.605	3.101	4
2.406	0.926	0.951	2.416	4	2.745	0.747	1.318	2.773	4	3.092	0.567	1.706	3.145	4
2.371	0.735	0.918	2.426	4	2.798	0.554	1.153	2.952	3	3.085	0.354	1.701	3.106	3
2.321	0.588	0.873	2.385	4	2.785	0.363	1.595	2.809	3	3.080	0.160	1.770	3.084	3
2.410	0.445	1.261	2.451	3	2.800	2.170	1.263	2.984	5	3.099	2.077	1.731	3.238	5
2.446	0.268	0.692	2.461	3	2.843	1.971	1.380	2.962	5	3.120	1.901	1.718	3.212	5
2.424	2.209	1.253	2.476	2	2.858	1.765	1.524	2.925	5	3.146	1.696	1.711	3.194	5
2.470	2.010	1.087	2.619	5	2.873	1.552	1.300	2.903	5	3.155	1.500	1.609	3.175	5
2.514	1.829	1.031	2.607	5	2.882	1.354	1.242	2.890	5	3.171	1.308	1.856	3.176	5
2.553	1.635	1.199	2.601	5	2.891	1.162	1.162	2.891	5	3.187	1.121	1.791	3.187	4
2.580	1.382	1.215	2.591	5	2.897	0.953	1.300	2.903	4	3.192	0.964	1.575	3.196	4
2.580	1.173	1.022	2.580	5	2.921	0.770	1.472	2.944	4	3.199	0.765	1.484	3.221	4
2.583	0.965	0.990	2.589	4	2.950	0.574	1.237	3.003	4	3.204	0.559	1.655	3.256	4
2.569	0.732	0.810	2.601	4	2.950	0.347	1.438	2.970	3	3.204	0.357	1.622	3.224	3
2.603	0.547	1.404	2.660	3	2.927	0.179	1.637	2.932	3	3.199	0.171	1.824	3.204	3
2.614	0.410	1.236	2.646	3	2.960	2.132	1.747	3.122	5					

AVERAGE DENSITIES AT SCALED TIME= 5.000 MS

X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE
2.537	2.039	1.017	2.691	5	2.902	2.215	1.071	3.095	5	3.193	0.972	1.142	3.197	4
2.596	1.871	0.981	2.699	5	2.945	2.017	1.168	3.073	5	3.231	0.793	1.304	3.250	4
2.645	1.679	1.071	2.699	5	2.965	1.807	1.314	3.039	5	3.256	0.583	1.414	3.324	4
2.667	0.983	0.928	2.672	4	2.993	1.590	1.066	3.017	5	3.259	0.362	1.318	3.279	3
2.652	0.752	0.720	2.651	4	2.994	1.383	1.031	3.004	5	3.257	0.162	1.307	3.261	3
2.705	0.572	1.238	2.764	4	2.999	1.182	0.897	3.000	5	3.252	2.128	1.21[illegible]	3.399	5
2.716	0.447	1.074	2.752	3	3.001	0.906	1.044	3.006	4	3.266	1.942	1.[illegible]3	3.363	5
2.692	2.232	1.001	2.935	5	3.044	0.791	1.361	3.064	4	3.291	1.730	1.534	3.344	5
2.742	2.048	1.119	2.888	5	3.098	0.594	1.013	3.145	4	3.308	1.538	1.328	3.332	5
2.790	1.850	1.025	2.879	5	3.098	0.360	1.145	3.119	3	3.331	1.345	1.428	3.337	5
2.800	1.621	0.858	2.841	5	3.064	0.195	1.217	3.070	3	3.354	1.147	1.252	3.354	5
2.809	1.402	1.276	2.821	5	3.036	2.179	1.379	3.257	5	3.366	0.989	1.116	3.369	4
2.829	1.187	1.334	2.829	5	3.116	1.977	1.346	3.227	5	3.374	0.781	1.112	3.393	4
2.529	0.982	1.245	2.834	4	3.144	1.761	1.234	3.205	5	3.385	0.567	1.289	3.433	4
2.848	0.762	1.156	2.872	4	3.164	1.563	1.179	3.192	5	3.399	0.363	1.260	3.418	3
2.926	0.576	0.924	2.981	4	3.191	1.361	1.334	3.199	5	3.403	0.167	1.285	3.407	3
2.911	0.387	1.613	2.937	3	3.194	1.166	1.208	3.194	5					

X AND Y LOCATE THE CENTER OF A PLANE QUADRILATERAL WHICH IS A CELL OF 4 NEIGHBOURING SMOKE PUFFS.
DENSITY IS AVERAGED OVER THE AREA OF THE CELL AND IS EXPRESSED AS A RATIO TO THE AMBIENT DENSITY.

OBSERVED DISTANCE VALUES= 8.1111 TIMES SCALED VALUES
AND OBSERVED TIME VALUE = 8.1069 TIMES SCALED VALUE.
DENSITY VALUES AS SHOWN ARE INVARIANT UNDER SCALING.

Table 8.3

DENSITY FIELD　　DIPOLE WEST/9　　WF5/295　　SMOKE PUFF GRID 1209　　/A770404

AVERAGE DENSITIES AT SCALED TIME= 6.000 MS

X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE
2.816	2.093	1.104	2.973	5	3.068	1.234	0.859	3.069	5	3.330	0.825	1.129	3.345	4
2.866	1.887	0.982	2.962	5	3.077	0.989	1.006	3.074	4	3.361	0.611	1.173	3.402	4
2.870	1.646	0.812	2.914	5	3.125	0.825	1.368	3.141	4	3.362	0.378	1.083	3.383	3
2.874	1.419	1.245	2.887	5	3.188	0.622	0.847	3.229	4	3.341	2.168	1.136	3.496	5
2.899	1.208	1.442	2.899	5	3.182	0.377	0.989	3.204	3	3.357	1.985	1.165	3.462	5
2.903	1.008	1.364	2.906	4	3.134	0.211	0.989	3.141	3	3.384	1.772	1.346	3.443	5
2.927	0.787	1.155	2.948	4	3.162	2.218	1.297	3.341	5	3.412	1.570	1.102	3.429	5
3.014	0.599	0.825	3.062	4	3.195	2.021	1.254	3.315	5	3.421	1.367	1.118	3.428	5
2.982	0.402	1.734	3.009	3	3.224	1.802	1.060	3.291	5	3.446	1.168	1.038	3.446	5
3.018	2.063	1.149	3.156	5	3.243	1.595	1.002	3.275	5	3.469	1.016	1.006	3.471	4
3.038	1.846	1.205	3.119	5	3.268	1.385	1.199	3.277	5	3.488	0.808	1.017	3.504	4
3.053	1.617	0.958	3.090	5	3.269	1.185	1.144	3.269	5	3.505	0.590	1.086	3.548	4
3.063	1.404	0.961	3.074	5	3.277	0.997	1.053	3.280	4	3.521	0.377	1.018	3.541	3

AVERAGE DENSITIES AT SCALED TIME= 7.000 MS

X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	DENSITY RATIO	R-SCAL METERS	REGN CODE
3.083	2.099	1.061	3.229	5	3.288	1.830	1.048	3.360	5	3.421	2.020	1.093	3.532	5
3.104	1.875	1.100	3.191	5	3.310	1.621	1.059	3.344	5	3.442	1.796	1.355	3.504	5
3.120	1.643	0.908	3.160	5	3.338	1.413	1.246	3.349	5	3.461	1.594	1.129	3.491	5
3.125	1.004	0.858	3.128	4	3.339	1.216	1.130	3.339	5	3.482	1.395	1.224	3.492	5
3.181	0.840	1.488	3.195	4	3.340	1.021	0.958	3.342	4	3.514	1.200	1.049	3.515	5
3.245	0.637	0.754	3.283	4	3.395	0.850	1.033	3.407	4	3.542	1.052	0.935	3.543	4
3.232	0.381	0.947	3.254	3	3.423	0.628	1.066	3.461	4	3.560	0.838	0.896	3.572	4
3.175	0.220	0.914	3.183	3	3.422	0.386	0.985	3.444	3	3.576	0.606	0.911	3.616	4
3.262	2.056	1.234	3.389	5	3.411	2.209	1.063	3.575	5	3.593	0.388	0.852	3.614	3

X AND Y LOCATE THE CENTER OF A PLANE QUADRILATERAL WHICH IS A CELL OF 4 NEIGHBOURING SMOKE PUFFS.
DENSITY IS AVERAGED OVER THE AREA OF THE CELL AND IS EXPRESSED AS A RATIO TO THE AMBIENT DENSITY.

OBSERVED DISTANCE VALUES= 8.1111 TIMES SCALED VALUES
AND OBSERVED TIME VALUE = 8.1069 TIMES SCALED VALUE.
DENSITY VALUES AS SHOWN ARE INVARIANT UNDER SCALING.

Table 9.1

PRESSURE FIELD   DIPOLE WEST/9   WF5/295   SMOKE PUFF GRID 1209   /A770404

AVÊRAGE HYDROSTATIC OVERPRESSURES AT SCALED TIME= 1.000 MS

X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE
1.332	1.076	2.406	1.333	2	1.524	1.885	0.667	1.534	2	1.517	0.570	0.768	1.517	1
1.322	1.481	2.779	1.341	2	1.534	1.316	1.203	1.544	5	1.522	0.372	0.963	1.535	1
1.331	0.963	3.016	1.343	4	1.552	1.134	1.394	1.552	5	1.563	0.202	0.886	1.576	3
1.330	0.776	4.493	1.346	1	1.531	0.931	1.716	1.545	4					
1.513	2.079	0.534	1.558	2	1.523	0.761	0.969	1.535	1					

AVERAGE HYDROSTATIC OVERPRESSURES AT SCALED TIME= 2.000 MS

X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE
1.755	2.151	0.698	1.810	2	2.018	0.415	3.255	2.060	3	2.134	0.210	2.371	2.144	3
1.790	1.949	0.760	1.806	2	2.031	0.236	1.140	2.044	3	2.302	1.687	0.160	2.366	5
1.853	0.751	1.661	1.893	4	2.081	2.068	0.725	2.113	2	2.309	1.505	0.241	2.338	5
1.850	0.559	1.945	1.850	1	2.091	1.879	1.030	2.098	2	2.327	1.318	0.348	2.334	5
1.851	0.377	1.840	1.889	3	2.104	1.704	1.514	2.179	5	2.318	1.133	0.370	2.318	4
1.926	2.104	1.916	1.966	2	2.136	1.528	1.984	2.171	5	2.312	0.953	0.349	2.319	4
1.951	1.908	2.043	1.962	2	2.154	1.333	1.877	2.163	5	2.313	0.759	0.341	2.344	4
2.037	1.355	0.794	2.049	5	2.153	1.140	2.222	2.153	5	2.318	0.568	0.229	2.387	4
2.043	1.132	1.260	2.043	4	2.148	0.946	2.365	2.156	4	2.295	0.378	0.219	2.326	3
2.039	0.909	2.113	2.052	4	2.133	0.750	2.218	2.168	4	2.309	0.196	0.234	2.318	3
2.015	0.727	1.974	2.057	4	2.125	0.575	3.414	2.199	4					
1.997	0.570	2.123	2.076	4	2.127	0.399	3.236	2.164	3					

AVERAGE HYDROSTATIC OVERPRESSURES AT SCALED TIME= 3.000 MS

X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE	X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE
1.901	2.221	0.049	1.969	2	2.430	1.146	0.762	2.430	5	2.684	1.330	1.241	2.691	5
1.940	2.011	-0.156	1.964	2	2.436	0.946	0.750	2.444	4	2.688	1.132	1.181	2.698	4
2.026	0.788	0.446	2.056	4	2.425	0.731	0.487	2.459	4	2.691	0.939	1.812	2.699	4
2.018	0.568	0.295	2.098	4	2.433	0.547	1.871	2.494	3	2.697	0.756	1.792	2.724	4
2.037	0.362	0.571	2.069	3	2.432	0.391	1.528	2.463	3	2.704	0.571	1.367	2.763	4
2.138	2.188	0.825	2.191	2	2.452	2.122	1.275	2.487	2	2.703	0.361	1.997	2.727	3
2.161	1.982	0.230	2.178	2	2.494	1.948	1.541	2.622	5	2.686	0.188	2.107	2.693	3
2.272	1.400	-0.251	2.287	5	2.527	1.757	1.010	2.602	5	2.817	2.073	0.073	2.968	5
2.283	1.155	0.084	2.284	5	2.578	1.548	0.633	2.571	5	2.831	1.893	0.169	2.929	5
2.291	0.913	0.602	2.302	4	2.551	1.339	1.478	2.559	5	2.846	1.690	0.236	2.898	5
2.262	0.723	0.343	2.300	4	2.565	1.137	1.677	2.565	5	2.852	1.502	0.289	2.875	5
2.226	0.566	0.227	2.299	4	2.568	0.944	1.502	2.575	4	2.862	1.308	0.454	2.867	5
2.281	0.412	1.072	2.318	3	2.561	0.743	1.734	2.592	4	2.861	1.126	0.526	2.861	4
2.300	0.235	0.339	2.312	3	2.580	0.547	1.270	2.637	3	2.853	0.945	0.532	2.860	4
2.300	2.153	1.391	2.343	2	2.567	0.360	1.654	2.592	3	2.862	0.766	0.587	2.887	4
2.330	1.961	0.580	2.471	5	2.609	2.090	1.110	2.777	5	2.868	0.573	0.601	2.923	4
2.371	1.791	0.411	2.459	5	2.643	1.904	1.728	2.752	5	2.860	0.375	0.497	2.885	3
2.410	1.589	0.678	2.452	5	2.664	1.718	1.973	2.727	5	2.855	0.189	0.461	2.862	3
2.428	1.346	0.849	2.437	5	2.680	1.523	1.679	2.707	5					

X AND Y LOCATE THE CENTER OF A PLANE QUADRILATERAL WHICH IS A CELL OF 4 NEIGHBOURING SMOKE PUFFS.
OVERPRESSURE IS AVERAGED OVER THE AREA OF THE CELL AND IS EXPRESSED AS A RATIO TO THE AMBIENT PRESSURE.

OBSERVED DISTANCE VALUES= 8.1111 TIMES SCALED VALUES
AND OBSERVED TIME VALUE = 8.1069 TIMES SCALED VALUE.
PRESSURE VALUES AS SHOWN ARE INVARIANT UNDER SCALING.

Table 9.2

PRESSURE FIELD   DIPCLE WEST/9   WFS/295   SMOKE PUFF GRID 1209   /A770404

AVERAGE HYDROSTATIC OVERPRESSURES AT SCALED TIME= 4,000 MS

X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE
2.031	2.034	-0.117	2.057	2
2.112	0.820	0.441	2.136	4
2.098	0.605	0.319	2.165	4
2.124	0.391	0.253	2.160	3
2.267	2.004	-0.154	2.286	2
2.399	1.443	-0.500	2.418	5
2.408	1.185	-0.264	2.409	5
2.406	0.926	0.131	2.416	4
2.371	0.735	0.031	2.406	4
2.321	0.598	-0.073	2.385	4
2.410	0.445	0.662	2.451	3
2.446	0.268	-0.251	2.461	3
2.424	2.209	0.449	2.476	2
2.470	2.010	0.203	2.619	5
2.514	1.829	0.154	2.607	5
2.553	1.635	0.457	2.601	5
2.58[illegible]	1.382	0.496	2.591	5
2.580	1.173	0.181	2.580	5
2.583	0.965	0.130	2.589	4
2.569	0.732	-0.150	2.601	4
2.603	0.547	0.854	2.660	3
2.614	0.410	0.578	2.646	3

X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE
2.616	2.193	0.353	2.821	5
2.659	2.007	0.441	2.797	5
2.695	1.803	0.217	2.776	5
2.702	1.583	0.[illegible]99	2.738	5
2.715	1.373	0.910	2.725	5
2.739	1.165	0.916	2.739	5
2.742	0.966	0.557	2.747	4
2.745	0.747	0.617	2.773	4
2.798	0.554	0.351	2.852	3
2.785	0.363	1.150	2.809	3
2.800	2.170	0.450	2.984	5
2.843	1.971	0.661	2.962	5
2.858	1.765	0.916	2.925	5
2.873	1.552	0.537	2.903	5
2.882	1.354	0.444	2.890	5
2.891	1.162	0.319	2.891	5
2.897	0.953	0.547	2.903	4
2.921	0.770	0.839	2.944	4
2.950	0.574	0.446	3.003	4
2.950	0.347	0.795	2.970	3
2.927	0.179	1.151	2.932	3
2.960	2.132	1.269	3.122	5

X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE
2.991	1.934	1.140	3.095	5
3.017	1.721	0.812	3.072	5
3.030	1.525	0.721	3.055	5
3.053	1.326	1.200	3.059	5
3.057	1.142	1.138	3.057	5
3.056	0.956	0.811	3.061	4
3.079	0.772	1.042	3.101	4
3.092	0.567	1.224	3.145	4
3.085	0.354	1.216	3.106	3
3.080	0.160	1.339	3.084	3
3.099	2.077	1.219	3.238	5
3.120	1.901	1.200	3.212	5
3.146	1.696	1.193	3.194	5
3.155	1.500	1.015	3.175	5
3.171	1.308	1.461	3.176	5
3.187	1.121	1.348	3.187	4
3.192	0.964	0.969	3.196	4
3.199	0.765	0.812	3.221	4
3.204	0.559	1.106	3.256	4
3.204	0.357	1.043	3.224	3
3.199	0.171	1.409	3.204	3

AVERAGE HYDROSTATIC OVERPRESSURES AT SCALED TIME= 5.000 MS

X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE
2.537	2.039	0.096	2.691	5
2.596	1.871	0.077	2.699	5
2.645	1.679	0.244	2.699	5
2.607	0.983	0.033	2.672	4
2.652	0.752	-0.278	2.681	4
2.705	0.572	0.554	2.764	4
2.716	0.447	0.229	2.752	3
2.692	2.232	0.045	2.905	5
2.742	2.048	0.252	2.888	5
2.790	1.850	0.129	2.879	5
2.800	1.621	-0.115	2.841	5
2.809	1.402	0.547	2.821	5
2.829	1.187	0.647	2.829	5
2.829	0.982	0.494	2.834	4
2.846	0.762	0.345	2.872	4
2.928	0.576	-0.010	2.981	4
2.911	0.387	1.185	2.937	3

X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE
2.902	2.215	0.151	3.095	5
2.945	2.017	0.316	3.073	5
2.965	1.807	0.558	3.039	5
2.983	1.590	0.163	3.017	5
2.994	1.383	0.113	3.004	5
2.999	1.182	-0.081	3.000	5
3.001	0.966	0.138	3.006	4
3.044	0.791	0.648	3.064	4
3.098	0.594	0.093	3.145	4
3.098	0.360	0.305	3.119	3
3.064	0.195	0.419	3.070	3
3.086	2.179	0.630	3.257	5
3.116	1.977	0.580	3.227	5
3.144	1.761	0.402	3.205	5
3.164	1.563	0.315	3.192	5
3.191	1.361	0.566	3.199	5
3.194	1.166	0.367	3.194	5

X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE
3.193	0.972	0.268	3.197	4
3.231	0.793	0.526	3.250	4
3.256	0.583	0.710	3.304	4
3.259	0.362	0.550	3.279	3
3.257	0.162	0.530	3.261	3
3.252	2.128	0.351	3.399	5
3.266	1.942	0.510	3.363	5
3.291	1.730	0.881	3.344	5
3.308	1.538	0.541	3.332	5
3.331	1.345	0.705	3.337	5
3.354	1.147	0.423	3.354	5
3.366	0.989	0.216	3.369	4
3.374	0.781	0.209	3.393	4
3.385	0.567	0.485	3.433	4
3.399	0.363	0.435	3.418	3
3.403	0.167	0.475	3.407	3

X AND Y LOCATE THE CENTER OF A PLANE QUADRILATERAL WHICH IS A CELL OF 4 NEIGHBOURING SMOKE PUFFS.
OVERPRESSURE IS AVERAGED OVER THE AREA OF THE CELL AND IS EXPRESSED AS A RATIO TO THE AMBIENT PRESSURE,

OBSERVED DISTANCE VALUES= 8.1111 TIMES SCALED VALUES
AND OBSERVED TIME VALUE = 8.1069 TIMES SCALED VALUE.
PRESSURE VALUES AS SHOWN ARE INVARIANT UNDER SCALING.

Table 9.3

PRESSURE FIELD   DIPOLE WEST/9   WF5/295   SMOKE PUFF GRID 1209   /A770404

AVERAGE HYDROSTATIC OVERPRESSURES AT SCALED TIME= 6.000 MS

X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE
2.816	2.093	0.229	2.973	5
2.860	1.887	0.063	2.962	5
2.870	1.646	-0.182	2.914	5
2.874	1.419	0.494	2.887	5
2.899	1.208	0.837	2.899	5
2.903	1.008	0.700	2.906	4
2.927	0.787	0.345	2.948	4
3.014	0.599	-0.155	3.062	4
2.982	0.402	1.417	3.009	3
3.018	2.063	0.285	3.156	5
3.038	1.846	0.380	3.119	5
3.053	1.017	0.002	3.090	5
3.063	1.404	0.009	3.074	5

X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE
3.068	1.204	-0.135	3.069	5
3.070	0.989	0.083	3.074	4
3.125	0.825	0.659	3.141	4
3.188	0.622	-0.149	3.229	4
3.182	0.377	0.063	3.204	3
3.134	0.211	0.061	3.141	3
3.162	2.218	0.495	3.341	5
3.195	2.021	0.430	3.315	5
3.224	1.802	0.132	3.291	5
3.243	1.595	0.047	3.275	5
3.268	1.385	0.349	3.277	5
3.269	1.185	0.267	3.269	5
3.277	0.997	0.131	3.280	4

X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE
3.330	0.825	0.248	3.345	4
3.361	0.611	0.317	3.402	4
3.362	0.378	0.177	3.383	3
3.341	2.168	0.230	3.496	5
3.357	1.985	0.276	3.462	5
3.384	1.772	0.566	3.443	5
3.402	1.570	0.186	3.429	5
3.421	1.367	0.210	3.428	5
3.446	1.166	0.095	3.446	5
3.469	1.016	0.051	3.471	4
3.488	0.808	0.067	3.504	4
3.505	0.590	0.167	3.548	4
3.521	0.377	0.064	3.541	3

AVERAGE HYDROSTATIC OVERPRESSURES AT SCALED TIME= 7.000 MS

X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE
3.085	2.099	0.149	3.229	5
3.104	1.875	0.214	3.191	5
3.120	1.643	-0.072	3.160	5
3.125	1.004	-0.135	3.128	4
3.181	0.840	0.867	3.195	4
3.245	0.037	-0.277	3.283	4
3.232	0.381	0.001	3.254	3
3.175	0.220	-0.050	3.183	3
3.262	2.056	0.399	3.389	5

X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE
3.288	1.830	0.114	3.360	5
3.310	1.621	0.131	3.344	5
3.338	1.413	0.424	3.349	5
3.339	1.216	0.246	3.339	5
3.340	1.021	-0.010	3.342	4
3.395	0.850	0.102	3.407	4
3.423	0.628	0.151	3.461	4
3.422	0.386	0.031	3.444	3
3.411	2.209	0.121	3.575	5

X-SCAL METERS	Y-SCAL METERS	PRESSURE RATIO	R-SCAL METERS	REGN CODE
3.421	2.020	0.167	3.532	5
3.442	1.796	0.581	3.504	5
3.461	1.594	0.226	3.491	5
3.482	1.395	0.374	3.492	5
3.514	1.200	0.111	3.515	5
3.542	1.052	-0.052	3.543	4
3.560	0.838	-0.106	3.572	4
3.576	0.606	-0.087	3.616	4
3.593	0.388	-0.171	3.614	3

X AND Y LOCATE THE CENTER OF A PLANE QUADRILATERAL WHICH IS A CELL OF 4 NEIGHBOURING SMOKE PUFFS.
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OBSERVED DISTANCE VALUES= 8.1111 TIMES SCALED VALUES
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PRESSURE VALUES AS SHOWN ARE INVARIANT UNDER SCALING.

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